# A Review of Infant Mortality in British Columbia: Opportunities for Prevention

## A Report of the Provincial Health Officer

P. R. W. Kendall, MBBS, MSc, FRCPC
Provincial Health Officer

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Ministry of Health Planning
Victoria, B.C.

October 28, 2003

**The Honourable Sindi Hawkins**
**Minister of Health Planning**

Madam:

I have the honour of presenting my report: "A Review of Infant Mortality in British Columbia: Opportunities for Prevention."

P. R. W. Kendall
MBBS, MSc, FRCPC
**Provincial Health Officer**

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## Introduction

The *Health Act*, Section 3(2), states that the Provincial Health Officer "must monitor the health of the people of British Columbia and provide to the people of British Columbia information and analyses on health issues."

This report, "A Review of Infant Mortality in British Columbia: Opportunities for Prevention", was requested by the Honourable Sindi Hawkins, Minister of Health Planning, following questions raised about increases in the infant mortality rates during the years 2001 and 2002, as reported by the B.C. Vital Statistics Agency (BCVSA).[1]

Infant mortality and low birth weight (LBW) rates are internationally accepted indicators of maternal and child health. They reflect not only on the state of health care within a jurisdiction, but also on the social environments, the policy supports, and the priority that a society places on childbearing.

## Summary of Findings

Infant mortality has been declining for decades in B.C., similar to the rest of Canada. This decline continued through the period of the mid 1980's to 2000. It reached an historic low of 3.7 deaths per 1,000 live births in the year 2000. The infant mortality rate rose in both 2001 and 2002 - to 4.0 deaths per 1,000 live births in 2001 and to 4.4 deaths per 1,000 live births in 2002. Over the last five years infant deaths have numbered 174 (1998), 158 (1999), 150 (2000), 162 (2001), and 177 (2002).

The increase in the number and rate of deaths in infants raises important questions. Does this indicate a trend, and as such could it be a marker for some underlying adverse condition or set of conditions in either health care and/or social determinants? Alternatively, could it represent a random fluctuation in a declining trend of relatively rare events?

This report analyses the available data looking for patterns that might indicate a systemic or sustained change in the mortality experience of infants from birth to age one. The report also looks at LBW in British Columbia. It concludes that on the balance of evidence presented there is no indication of a change in the pattern of mortality or morbidity, and increases in the infant mortality rates in 2001 and 2002 were the result of random fluctuations in relatively rare events.

A large proportion of the excess deaths were due to an increase in 2001 and 2002 in premature, low birth weight infants who are at very high risk. No underlying maternal factor was evident that might account for this increase. It is important to emphasize that even though we could find no underlying reasons for the recently observed increase in mortality, our societal goal is to improve infant health and reduce infant mortality to the lowest level possible.

In comparing B.C. infant mortality rates and rates of LBW to other jurisdictions in Canada and comparable industrialized nations, B.C. outcomes compare favourably within Canada. However, international comparisons indicate that Canada and B.C. could improve infant outcomes. This report makes a number of recommendations, which if implemented, could lead to improved birth outcomes in British Columbia.

1. Unless otherwise indicated, data in this report have been provided by BCVSA.

This review of infant mortality in B.C. has found that:

1. The infant mortality rate in B.C. has been declining for many years, but may now be approaching a point at which it may begin to level off. While our rates compare favourably with other jurisdictions in Canada and parts of Europe, they are not as low as Japan and some European countries.

2. While infant mortality has declined, the stillbirth rates in B.C. have remained unchanged over the last 16 years. This merits analysis beyond the scope of this review.

3. While the LBW rate in B.C. is comparable to other jurisdictions in Canada and parts of Europe, our rates are not as low as some European countries. While infant mortality has declined, the LBW rates in B.C. have remained unchanged at 5 per cent over the last 16 years, which merits analysis beyond the scope of this review.

4. The infant mortality rates for 2001 and 2002 were higher than the rates in 1999 and 2000, but the difference did not achieve statistical significance, and on the balance of evidence is believed to be a chance variation in the long term declining trend.

5. The excess in infant mortality of 31 additional deaths in 2001 and 2002 can be attributed in large part to an additional 27 deaths amongst infants of <1,500 grams and <28 weeks gestation - a group of infants with a particularly high mortality risk. As the mortality rate of other infants decreases over time, the mortality experience of this group is contributing proportionally more to the overall infant mortality rate.

6. The data clearly show that LBW infants have an increased risk of mortality, with the highest mortality occurring in the lowest weight infants. The pattern is similar for gestational age.

7. The proportion of pre-term (<37 weeks) births has increased significantly from 6.1 per cent in 1987 to 7.1 per cent in 2002.

8. Multiple births have increased significantly from 2.1 per cent in 1987 to 3.0 per cent in 2002, with the increase predominantly occurring in mothers aged 35+ years. The LBW rate for multiple births is close to 50 per cent. The potential role of infertility treatment and the associated risks merit further analysis that is beyond the scope of this review.

9. Status Indian infants have an increased rate of post-neonatal mortality (statistically significant), and increased rates of LBW and stillbirths (neither are statistically significant).

10. An unpublished B.C. study found that poverty was associated with poor pregnancy outcomes, and that poorer neighbourhoods had a disproportionately high number of Aboriginal people.

11. Services such as the Pregnancy Outreach Program (POP) have been established to support at-risk pregnant women in B.C. and other provinces. Evaluation at the national level has found such services to be effective in increasing the birth weights of babies born to at-risk mothers.

12. Statistics in the annual report of POP in B.C. indicate that while an estimated 23 per cent of all mothers of LBW infants receive POP services, many POP sites report that they are unable to meet the demand for their services.

## Recommendations

Based on the information reviewed for this report, it is recommended that:

1. B.C. should establish a goal of attaining the lowest achievable infant mortality rates.

2. As a long-term tool to develop effective maternal and child health services, the Canadian Perinatal Surveillance System framework for preventable fetal-infant mortality should be assessed by Health Authorities, B.C. Children's and B.C. Women's Hospitals, the B.C. Reproductive Care Program, Aboriginal representatives, concerned professional groups, and appropriate other interested parties. The framework should be adapted for application in B.C., with a view to determining specific strategies for future improvement in our rates of low birth weight, stillbirths, and infant deaths. Issues include the selection of appropriate benchmarks, reproductive trends, the diversity of our population, and disparities based on social, ethnic, or regional factors.

3. The Ministries of Health, the Health Authorities, B.C. Children's and B.C. Women's Hospitals, the B.C. Reproductive Care Program, Aboriginal representatives, concerned professional groups, and appropriate other interested parties should collaborate in the monitoring of infant health outcomes and the evaluation of maternal and child health services in order to attain the best possible health outcomes for babies and mothers in B.C. Particular attention should be placed on disparities.

4. In the short-term, pending the availability and application of the results of that assessment, the role of Pregnancy Outreach Program (POP) services in B.C. should be reviewed, in order to determine how more women with at-risk pregnancies could benefit from these services. The value of these services is supported by a growing evidence base, suggesting that POP services can be regarded as an important complement to the core function of maternal and child health services as provided by community health nurses, physicians, and midwives.

5. In view of the disparities noted in this report, a major emphasis should be placed on improving maternal and infant health in Aboriginal communities.

6. The provincial and federal governments should give consideration to ways in which the income status of pregnant women can be improved (e.g., create a maternal nutrition benefit to start once pregnancy is confirmed, that becomes the Child Benefit once the birth is registered). Such a benefit would be cost-neutral if the Child Benefit program was terminated 6 months earlier than at present.

## Definitions and Methods

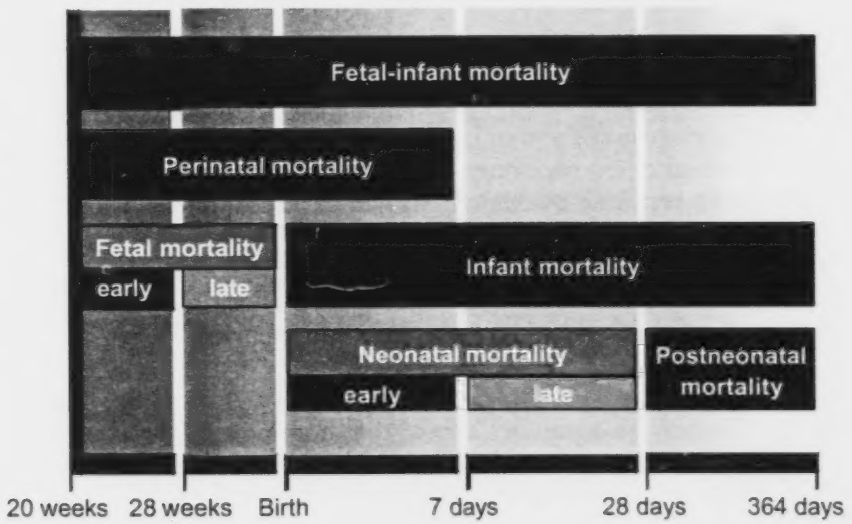
The following terms are used in this report:

- *Infant Death - the death of a liveborn infant less than one year of age (<365 days).*
- *Infant Mortality Rate - the number of infant deaths per 1,000 live births in a calendar year.**
- *Neonatal Death - the death of a liveborn infant aged 0-27 days.*
- *Early Neonatal Death - the death of a liveborn infant aged 0-6 days.*
- *Late Neonatal Death - the death of a liveborn infant aged 7-27 days.*
- *Post-Neonatal Death - the death of a liveborn infant aged 28-364 days.*
- *Stillbirth** - a fetus, which after complete expulsion or extraction from its mother, after at least 20 weeks of pregnancy, or after attaining a weight of at least 500 grams, has no vital signs.*
- *Perinatal Mortality Rate - the number of stillbirths and early neonatal deaths per 1,000 total births.*
- *Live Birth - birth of an infant with vital signs, not specified by birth weight or gestational age.*
- *Total Births - the of live births and stillbirths.*
- *Low Birth Weight Baby - a newborn whose weight is less than 2500 grams.*

* Note that while the infant births and deaths occur in the reference calender year, the infants who die may be born in that year or the preceding year. This may contribute to the fluctuation in annual rates for rare events, particularly in subgroups e.g., infants <1500 grams and <28 weeks.

** For legal definition, see B.C. Vital Statistics Agency Annual Report, 2002: 138.

**Components of Fetal-Infant Mortality***




* Source: "Perinatal Health Indicators for Canada", Canadian Perinatal Surveillance System, Health Canada, 2000: 83.

For comparisons of rates and proportions, 95 per cent confidence intervals were calculated for rarely occurring events according to Haenszel et al (1962), reproduced in D. Lilienfeld and P. Stolley, Foundations of Epidemiology, Oxford Press, 1994:303. Log-linear regression analysis (MS Excel) was used for the assessment of trends over time.

# Analysis

## Causes of Infant Death

Many different causes of death contribute to infant mortality, and this report will review the major causes of death to determine whether any recent changes in the pattern have occurred (see table A). Over the last four years, there have been 647 infant deaths in B.C., of which about half (51 per cent) were due to perinatal conditions, the most common major category. These conditions originate in that critical time shortly before, during, and after the birth process when the infant is most vulnerable.

**Table A: Major Causes of Infant Deaths, B.C., 1999-2002**

| Cause of Death | ICD-10 Code(s) | Infant Deaths | Percentage |
|---|---|---|---|
| Perinatal conditions | | | |
| Infant affected by maternal factors | P00-P04 | 120 | 19 |
| Premature/postmature and fetal growth disorders | P05-P08 | 47 | 7 |
| Birth trauma | P10-P15 | 4 | 1 |
| Respiratory and cardiovascular disorders | P20-P29 | 82 | 13 |
| Infections specific to the perinatal period | P35-P39 | 18 | 3 |
| Hemorrhage and hematological disorders | P50-P61 | 25 | 4 |
| Transitory endocrine and metabolic disorders | P70-P74 | 1 | 0 |
| Digestive system disorders of fetus and newborn | P75-P78 | 2 | 0 |
| Other disorders originating in the perinatal period | P80-P94, P96 | 31 | 5 |
| Fetal death of unknown cause | P95 | 0 | 0 |
| Total deaths due to perinatal conditions | P00-P96 | 330 | 51 |
| Congenital anomalies | | | |
| - of the nervous system | Q00-Q07 | 24 | 4 |
| - of the eye, ear, face & neck | Q10-Q18 | 0 | 0 |
| - of the heart and circulatory system | Q20-Q28 | 53 | 8 |
| - of the respiratory system | Q30-Q34 | 20 | 3 |
| - of the digestive system | Q35-Q45 | 3 | 0 |
| - of the genital organs | Q50-Q56 | 0 | 0 |
| - of the urinary system | Q60-Q64 | 4 | 1 |
| - of the musculoskeletal system | Q65-Q79 | 14 | 2 |
| Other and multiple system syndromes | Q80-Q89 | 15 | 2 |
| Chromosomal anomalies | Q90-Q99 | 28 | 4 |
| Total deaths due to congenital anomalies | Q00-Q99 | 161 | 25 |
| Pneumonia/influenza | J10-J18.1, J18.8-J18.9 | 5 | 1 |
| Sudden infant death syndrome (SIDS) | R95 | 56 | 9 |
| Other causes* | | 95 | 15 |
| TOTAL | | 647 | 100 |

* All other causes of death. Some infant deaths that were still under investigation (R99) may later be identified as SIDS.

The largest diagnostic grouping (19 per cent) within perinatal conditions was deaths due to the fetus and newborn being affected by maternal factors and complications of pregnancy, labour and delivery. The next largest category (13 per cent) was deaths due to respiratory and cardiovascular disorders specific to the perinatal period.

After perinatal conditions, the next largest major diagnostic category was congenital anomalies (25 per cent), of which the largest grouping (8 per cent) involved defects of the heart and circulatory system. The next largest major diagnostic category (9 per cent) was Sudden Infant Death Syndrome (SIDS), with pneumonia/influenza and all other causes comprising 16 per cent of infant deaths.

## The Pattern and Trend of Infant Mortality in B.C.

Infant mortality rates for the five-year combined period 1998 to 2002 by Health Authority and Health Service Delivery Area were examined in table B.[2] No Health Authority or Health Service Delivery Area had a rate which differed significantly from the provincial average.

**Table B: Infant Mortality by Health Service Delivery Area and Health Authority, B.C., 1998 to 2002**

| Health Jurisdiction | Mortality Indicators | | |
|---|---|---|---|
| **Health Service Delivery Area** | **Observed Deaths** | **Ratio*** **p**** | **Rate***** |
| 011 East Kootenay | 8 | 0.57 | 2.29 |
| 012 Kootenay Boundary | 16 | 1.23 | 4.91 |
| 013 Okanagan | 48 | 0.91 | 3.65 |
| 014 Thompson/Cariboo | 48 | 1.22 | 4.87 |
| 021 Fraser Valley | 61 | 1.03 | 4.11 |
| 022 Simon Fraser | 95 | 0.83 | 3.34 |
| 023 South Fraser | 150 | 1.05 | 4.20 |
| 031 Richmond | 33 | 1.04 | 4.16 |
| 032 Vancovuer | 117 | 1.03 | 4.13 |
| 033 North Shore/Coast Garibaldi | 37 | 0.76 | 3.03 |
| 041 South Vancouver Island | 64 | 0.96 | 3.84 |
| 042 Central Vancouver Island | 47 | 1.18 | 4.72 |
| 043 North Vancouver Island | 18 | 1.49 | 5.94 |
| 051 Northwest | 28 | 1.29 | 5.14 |
| 052 Northern Interior | 33 | 0.96 | 3.82 |
| 053 Northeast | 18 | 1.04 | 4.12 |
| **Health Authority** | | | |
| 01 Interior | 120 | 1.01 | 4.03 |
| 02 Fraser | 306 | 0.97 | 3.87 |
| 03 Vancouver Coastal | 187 | 0.96 | 3.86 |
| 04 Vancouver Island | 129 | 1.09 | 4.35 |
| 05 Northern Interior | 79 | 1.07 | 4.29 |
| **British Columbia** | 821 | 1.00 | 4.00 |

* Ratio = observed over the expected deaths.

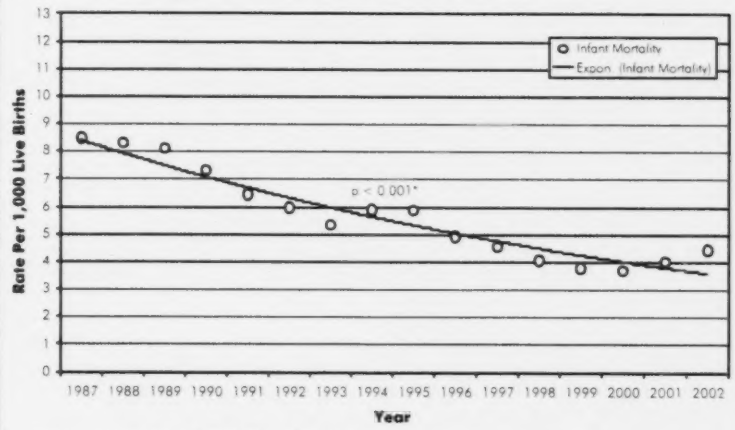
** An asterisk in this column would mean statistical testing indicated that observed deaths were significantly different from the expected deaths ($p<0.05$, two tailed). No differences were statistically significant in this time period.

*** Rate per 1,000 live births in the specified Health Area.

2. Table B prepared by BCVSA.

The B.C. infant mortality trend was examined further in figure 1, which indicates an overall decline[3] which was statistically significant.

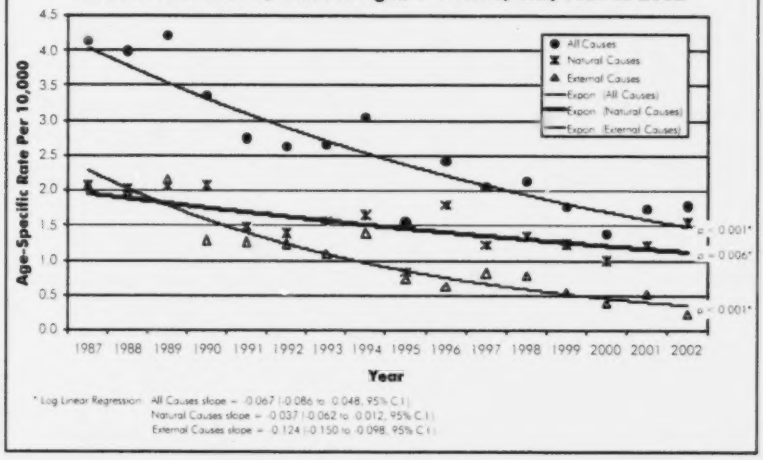
**Figure 1. Infant Mortality Rates, B.C. 1987-2002**


Rate Per 1,000 Live Births
Infant Mortality
Expon. (Infant Mortality)
p < 0.001*
Year
* Log Linear regression, slope = -0.057 (-0.067 to -0.046, 95% CI)

However, it appears that the mortality rate may be approaching a plateau, and if so, subsequent incremental improvements in infant mortality may be smaller in degree and occur over a longer time frame.

**[Note the difference in scale in figure 2.]**

**Figure 2. Age-Specific Mortality Rates, All Causes, Natural Causes, and External Causes, Children Aged 1-4 Years, B.C., 1987 to 2002**


Age-Specific Rate Per 10,000
All Causes
Natural Causes
External Causes
Expon. (All Causes)
Expon. (Natural Causes)
Expon. (External Causes)
p < 0.001*
p = 0.006*
p < 0.001*
Year
* Log Linear Regression: All Causes slope = -0.067 (-0.086 to -0.048, 95% CI)
Natural Causes slope = -0.037 (-0.062 to -0.012, 95% CI)
External Causes slope = -0.124 (-0.150 to -0.098, 95% CI)

In order to place the infant mortality trend into context, age-specific mortality rates for ages 1-4 years are shown in figure 2. All declining trends were statistically significant, with the average annual decline of 12.5 per cent in external causes (injuries) being greater than the average annual decline of 3.7 per cent for natural causes (illnesses).

Both external and natural causes mortality were about 2 per 10,000 in 1987, with external causes declining to less than 0.5 per 10,000 and natural causes declining to around 1.5 per 10,000 by 2002. Deaths due to illness now comprise a larger portion of the mortality risk for preschool children as death due to injury has had a proportionally greater decrease.

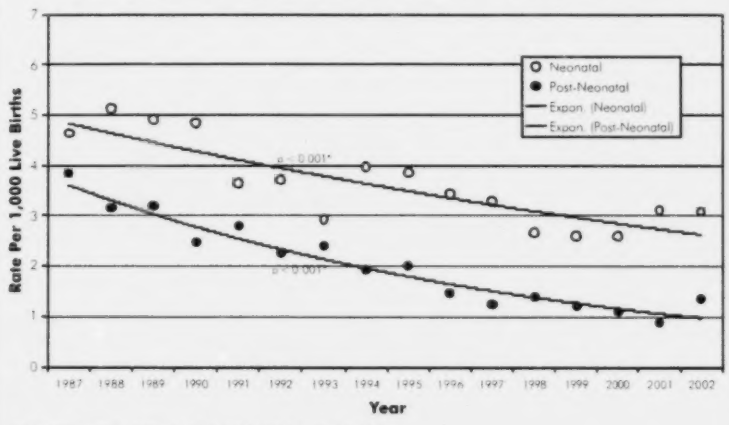
3. Log linear regression analysis found the slope to be –0.057, which means that the average annual rate of decline in mortality over this period was 5.7 per cent.

A statistically significant decline was apparent in both neonatal and post-neonatal mortality (see figure 3), with the average annual rate of decline being greater for post-neonatal mortality (8.7 per cent) than for neonatal mortality (4.0 per cent).

Neonatal mortality can be positively influenced by optimal newborn care, including access to neonatal intensive care, while post-neonatal mortality is largely attributable to factors in the infant environment (e.g., immunization, injury prevention, and various factors that reduce the risk of SIDS, such as breastfeeding, avoiding tobacco smoke, and "back-to-sleep position").

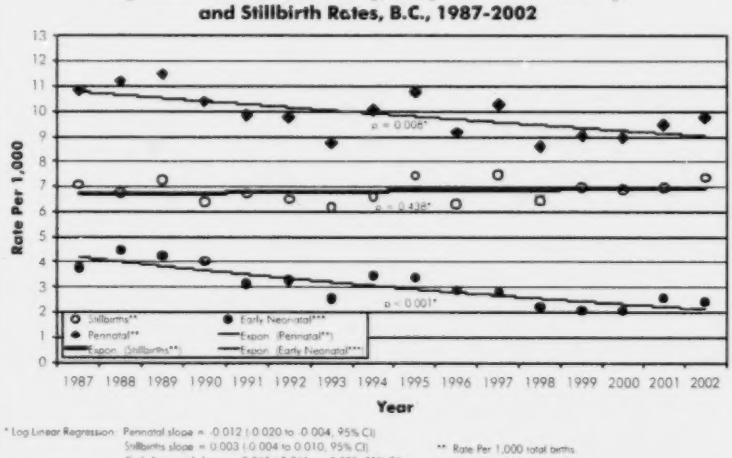
While not a component of infant mortality, the stillbirth rate fluctuated around 7 per 1,000, with no change in trend (see figure 4).[4] While the apparent plateau in the stillbirth rate may represent the approach of an absolute low, more needs to be learned about the possible role of multiple pregnancy and other factors.

**Figure 3. Neonatal and Post-Neonatal Mortality, B.C., 1987-2002**




* Log Linear Regression: Neonatal slope = -0.041 (-0.055 to -0.026 95% CI)
Post-Neonatal slope = -0.087 (-0.102 to -0.072, 95% CI)

**Figure 4. Perinatal Mortality, Early Neonatal Mortality, and Stillbirth Rates, B.C., 1987-2002**



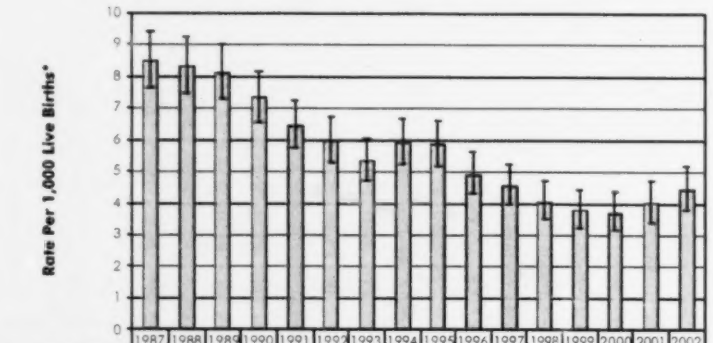

* Log Linear Regression: Perinatal slope = -0.012 (-0.020 to -0.004, 95% CI)
Stillbirths slope = 0.003 (-0.004 to 0.010, 95% CI)
Early Neonatal slope = -0.045 (-0.061 to -0.030, 95% CI)

** Rate Per 1,000 total births
*** Rate Per 1,000 live births

The stillbirth rate can be positively influenced by optimal maternal care, including access to caesarian delivery. In recent years the caesarian section rate has increased to 27.9 per cent of live births in 2002, the highest rate ever recorded in B.C.[5] The early neonatal mortality rate (a component of neonatal mortality) showed a statistically significant decline over time. The perinatal mortality rate (a composite indicator which includes stillbirths and early neonatal deaths) also showed a statistically significant decline, due to the decline in early neonatal mortality.

4. B.C. Vital Statistics Agency, 2002 Annual Report, 12. The stillbirth rate has fluctuated between 6.2 and 7.7 per 1,000 since 1982. Earlier, the stillbirth rate declined from a high of 13.4 in 1950 to around 8.0 by the late 1970s.
5. Ibid, 18.

**Figure 5. Infant Mortality Rates, B.C., 1987-2002**



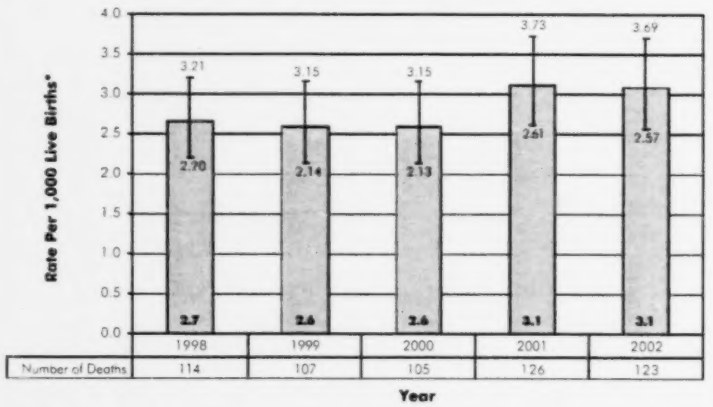

| | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of Deaths | 353 | 356 | 353 | 332 | 293 | 275 | 245 | 276 | 274 | 226 | 202 | 174 | 158 | 150 | 162 | 177 |
| Rate Per 1,000 | 8.48 | 8.31 | 8.10 | 7.32 | 6.44 | 5.96 | 5.33 | 5.89 | 5.87 | 4.92 | 4.55 | 4.06 | 3.78 | 3.70 | 4.01 | 4.44 |

Year

* With 95% Confidence Intervals

Annual infant mortality rates were graphed with 95 per cent confidence intervals (see figure 5), which show that the lower rates in the last five years were significantly different than the rates in all of the years prior to 1996, with the exception of 1993.

**Figure 6. Neonatal Mortality Rates, B.C., 1998-2002**



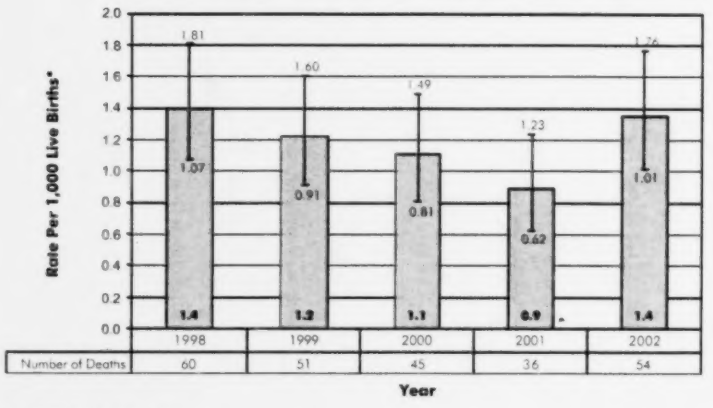

| | 1998 | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|---|
| Number of Deaths | 114 | 107 | 105 | 126 | 123 |

Year

* With 95% Confidence Intervals

The obvious question, which cannot be answered with certainty as of yet, is whether the pattern following 2001-2002 will be similar to that following 1994-1995. Preliminary data to September 30, 2003, indicates an infant mortality rate of 3.8 per 1,000 in the current year.

**Figure 7. Post-Neonatal Mortality Rates, B.C., 1998-2002**




| | 1998 | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|---|
| Number of Deaths | 60 | 51 | 45 | 36 | 54 |

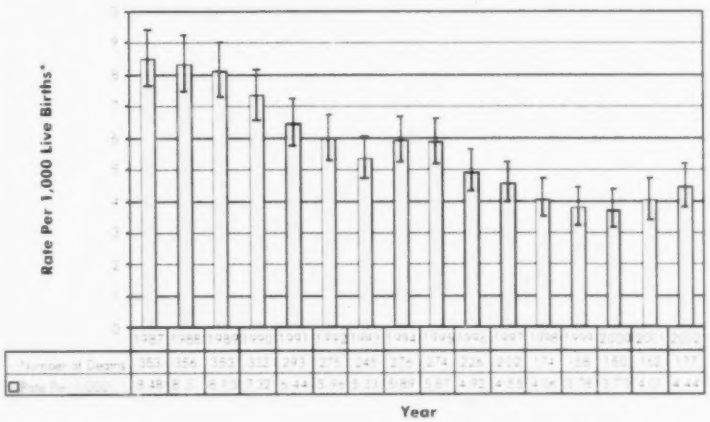
Year

* With 95% Confidence Intervals

While fluctuation in rates occurred in the past, the data show that the increased rates observed in 1994 and 1995 were not significantly higher than the rate in 1993, nor was the rate in 1993 significantly lower than the rates in the previous two years.

Focusing on the last five years, similar comparisons were made for neonatal, post-neonatal, stillbirth, early neonatal, and perinatal mortality rates (see figures 6-10).

**Figure 5. Infant Mortality Rates, B.C., 1987-2002**




Annual infant mortality rates were graphed with 95 per cent confidence intervals (see figure 5), which show that the lower rates in the last five years were significantly different than the rates in all of the years prior to 1996, with the exception of 1993.

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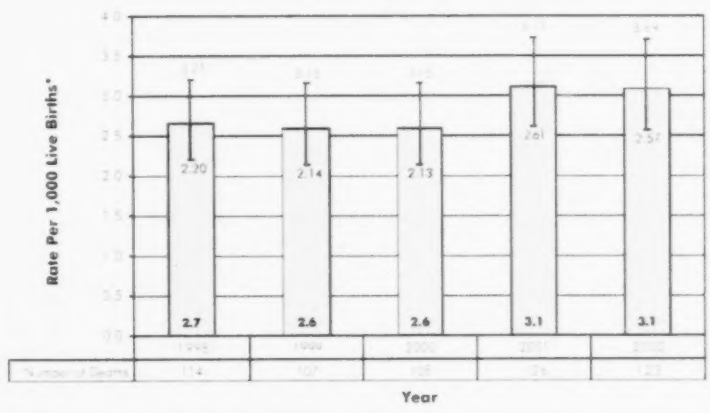
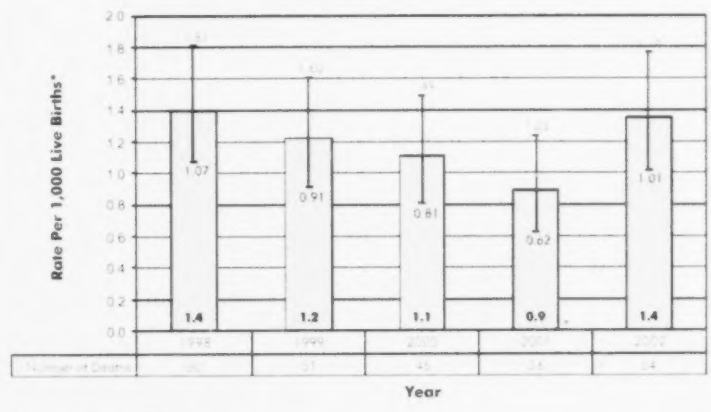



The obvious question, which cannot be answered with certainty as of yet, is whether the pattern following 2001-2002 will be similar to that following 1994-1995. Preliminary data to September 30, 2003, indicates an infant mortality rate of 3.8 per 1,000 in the current year.

**Figure 7. Post-Neonatal Mortality Rates, B.C., 1998-2002**




While fluctuation in rates occurred in the past, the data show that the increased rates observed in 1994 and 1995 were not significantly higher than the rate in 1993, nor was the rate in 1993 significantly lower than the rates in the previous two years.

Focusing on the last five years, similar comparisons were made for neonatal, post-neonatal, stillbirth, early neonatal, and perinatal mortality rates (see figures 6-10).

Most of these indicators were higher in both 2001 and 2002 than in 2000. For post-neonatal mortality, the 2001 rate was lower than in 2000, while the 2002 rate was higher.

In summary, while annual fluctuation was evident, there were no statistically significant differences found among the annual rates for any of these indicators throughout the last five years.

**Figure 8. Stillbirth Rates, B.C., 1998-2002**

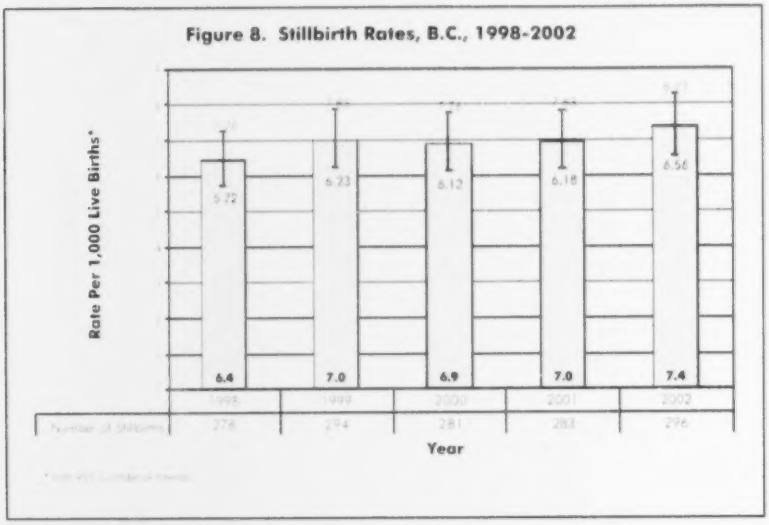



**Figure 9. Early Neonatal Mortality Rates, B.C., 1998-2002**

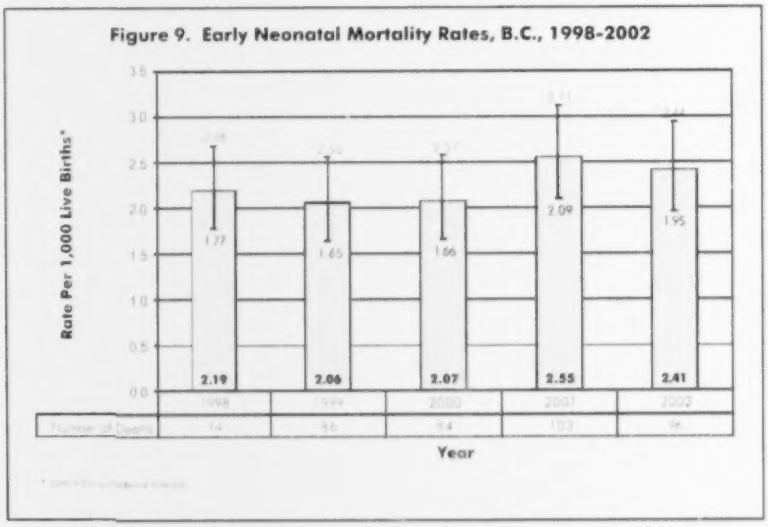



**Figure 10. Perinatal Mortality Rates, B.C., 1998-2002**

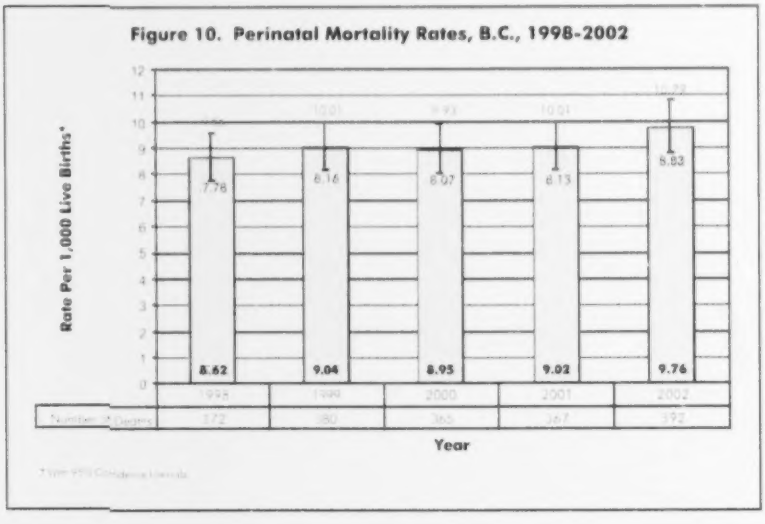
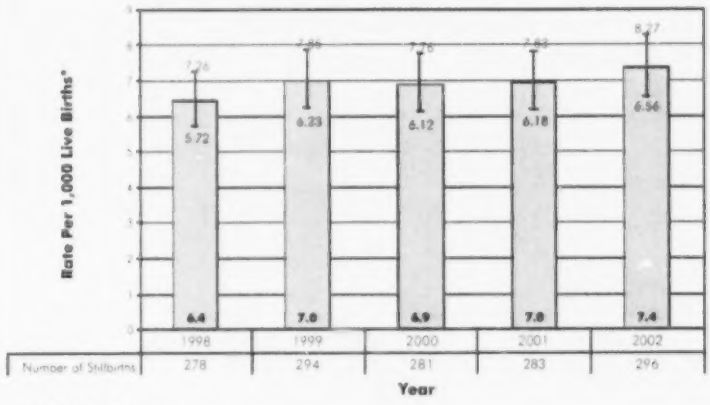


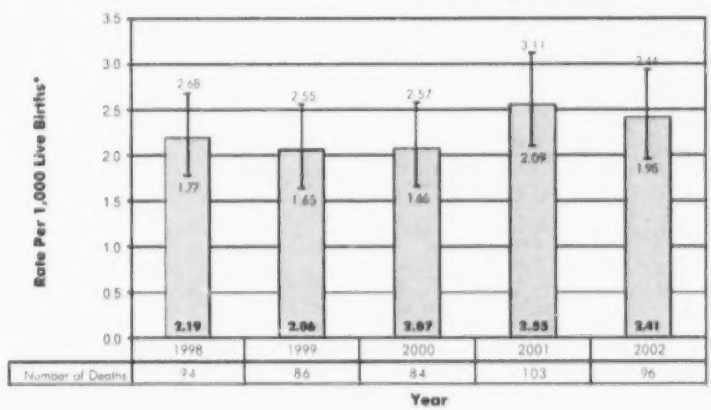
**Figure 8. Stillbirth Rates, B.C., 1998-2002**




* With 95% Confidence Intervals

Most of these indicators were higher in both 2001 and 2002 than in 2000. For post-neonatal mortality, the 2001 rate was lower than in 2000, while the 2002 rate was higher.

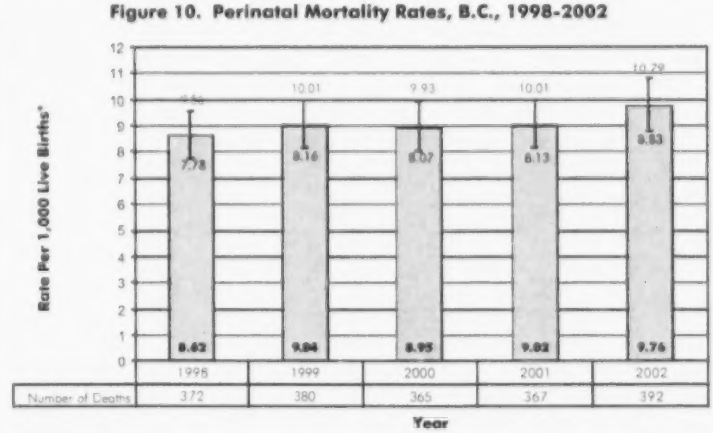
**Figure 9. Early Neonatal Mortality Rates, B.C., 1998-2002**




* With 95% Confidence Intervals

In summary, while annual fluctuation was evident, there were no statistically significant differences found among the annual rates for any of these indicators throughout the last five years.

**Figure 10. Perinatal Mortality Rates, B.C., 1998-2002**

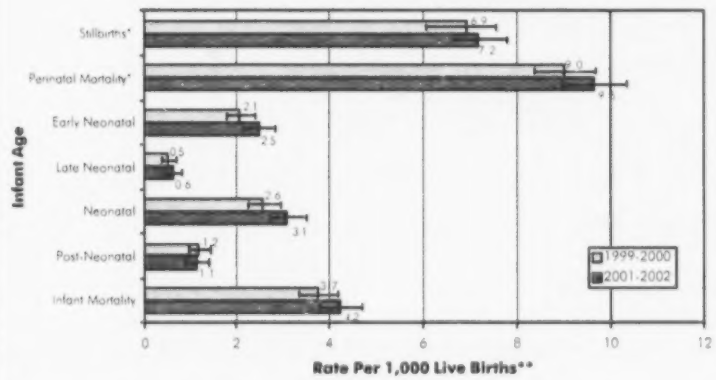



* With 95% Confidence Intervals

## A Detailed Analysis of Infant Mortality from 1999 to 2002

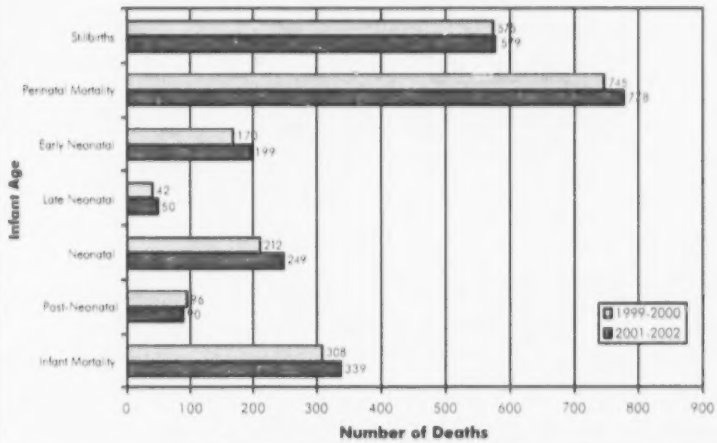
As increased infant mortality occurred in both 2001 and 2002, a comparison was made between the higher rates in those years combined and the lower rates in 1999 and 2000 combined (see figures 11 and 12).

**Figure 11. Infant and Perinatal Mortality Rates, B.C., 1999-2000 and 2001-2002**




* Stillbirth and Perinatal Mortality Rates per 1,000 total births
** With 95% Confidence Intervals

**Figure 12. Infant and Perinatal Deaths, B.C., 1999-2000 and 2001-2002**




Combining data for these years also provided larger numbers to better enable any differences to achieve statistical significance. These data show that while the overall provincial infant mortality rate was higher in the latter period, the difference was not statistically significant.[6]

All indicators except post-neonatal mortality were higher in the latter period. Post-neonatal mortality was slightly lower in the latter two years. None of the differences were statistically significant. (See Appendix B for data by Health Authority.)

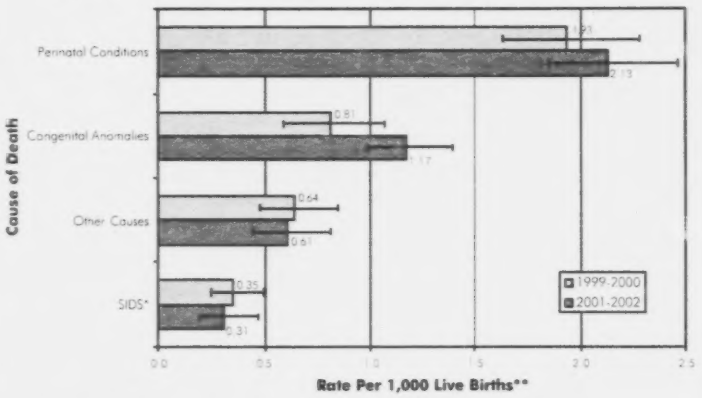
Thus, the higher infant and perinatal mortality rate indicators for 2001 and 2002 were not significantly different than the rates for 1999 and 2000, whether viewed annually or with the combined year comparisons.

In order to better understand the pattern of infant mortality, the various causes of infant deaths were examined, beginning with the major categories of perinatal conditions, congenital anomalies, sudden infant death syndrome (SIDS), and all other causes. These three major causes were responsible for approximately 85 per cent of infant deaths.

6. A customary method of assessing such differences is to compare the observed mortality with the expected mortality. Based on the trend, the expected mortality for 2001 was 3.8 and for 2002 was 3.6 per 1,000. When the combined expected mortality for 2001-2002 was calculated, the value was 3.7 per 1,000, which was no different than the actual combined 1999-2000 rate, the basis of comparison in this report.

The same combined-year comparisons were made for the major causes of infant death (see figures 13 and 14). Neither the higher mortality for perinatal conditions and congenital anomalies, nor the lower mortality for SIDS and other causes, were statistically significant.

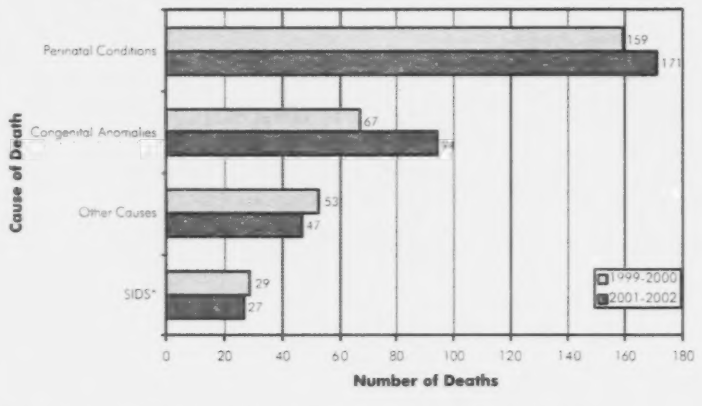
**Figure 13. Infant Mortality Rates, B.C., 1999-2000 and 2001-2002**




* In recent data, particularly 2002, it is possible that some cases currently classified as due to unknown cause (and currently included in the Other Cause category) may later be diagnosed as SIDS once investigations are concluded.
** With 95% Confidence Intervals

However, the increased mortality for perinatal conditions and congenital anomalies was greater than the decreased mortality in SIDS and other causes, and thus, accounted for the higher infant mortality in 2001-2002.

**Figure 14. Infant Mortality, B.C., 1999-2000 and 2001-2002**




* In recent data, particularly 2002, it is possible that some cases currently classified as due to unknown cause (and currently included in the Other Cause category) may later be diagnosed as SIDS once investigations are concluded.

A detailed listing of infant deaths reported in 1999-2000 and 2001-2002 can be found in tables C and D.[7] Of the 10 types of congenital anomaly listed, no statistically significant difference by type was observed. Although twice as many infant deaths were attributed to "premature/postmature and fetal growth disorders"[8] in 2001-2002 (31) as compared to 1999-2000 (16), there were 18 fewer deaths due to "respiratory and cardiovascular disorders" in 2001-2002 as compared to 1999-2000. None of the differences by individual cause of death were statistically significant, and hence no single specific cause accounted for the increased number of deaths.

7. See Appendix C for similar tables of stillbirths and perinatal deaths.
8. Almost all of the deaths in this diagnostic category occurred to infants who were both <28 weeks and <2500 grams.

## Table C: Number of Infant Deaths by Selected Causes, B.C., 1999-2000 and 2001-2002

| Cause of Death | ICD-10 Code(s) | Infant Deaths | | Increased Deaths in 2001-2002* |
|---|---|---|---|---|
| | | 1999-2000 | 2001-2002 | |
| Perinatal conditions | | | | |
| Infant affected by maternal factors | P00-P04 | 55 | 65 | 10 |
| Premature/postmature and fetal growth disorders | P05-P08 | 16 | 31 | 15 |
| Birth trauma | P10-P15 | 4 | 0 | -4 |
| Respiratory and cardiovascular disorders | P20-P29 | 50 | 32 | -18 |
| Infections specific to the perinatal period | P35-P39 | 11 | 7 | -4 |
| Hemorrhage and hematological disorders | P50-P61 | 9 | 16 | 7 |
| Transitory endocrine and metabolic disorders | P70-P74 | 1 | 0 | -1 |
| Digestive system disorders of fetus and newborn | P75-P78 | 0 | 2 | 2 |
| Other disorders originating in the perinatal period | P80-P94, P96 | 13 | 18 | 5 |
| Fetal death of unknown cause | P95 | 0 | 0 | 0 |
| Total deaths due to perinatal conditions | P00-P96 | 159 | 171 | 12 |
| Congenital anomalies | | | | |
| - of the nervous system | Q00-Q07 | 9 | 15 | 6 |
| - of the eye, ear, face & neck | Q10-Q18 | 0 | 0 | 0 |
| - of the heart and circulatory system | Q20-Q28 | 22 | 31 | 9 |
| - of the respiratory system | Q30-Q34 | 13 | 7 | -6 |
| - of the digestive system | Q35-Q45 | 2 | 1 | -1 |
| - of the genital organs | Q50-Q56 | 0 | 0 | 0 |
| - of the urinary system | Q60-Q64 | 2 | 2 | 0 |
| - of the musculoskeletal system | Q65-Q79 | 4 | 10 | 6 |
| Other and multiple system syndromes | Q80-Q89 | 4 | 11 | 7 |
| Chromosomal anomalies | Q90-Q99 | 11 | 17 | 6 |
| Total deaths due to congenital anomalies | Q00-Q99 | 67 | 94 | 27 |
| Pneumonia/influenza | J10-J18.1, J18.8-J18.9 | 4 | 1 | -3 |
| Sudden infant death syndrome (SIDS) | R95 | 29 | 27 | -2 |
| Other causes** | | 49 | 46 | -3 |
| TOTAL | | 308 | 527 | 219 |

* Causes with an increase of 5 or more are included in Table D.

** All other causes of death. Some infant deaths that were still under investigation (R99) may later be identified as SIDS.

## Table D: Rates of Infant Deaths by Selected Causes, B.C., 1999-2000 and 2001-2002

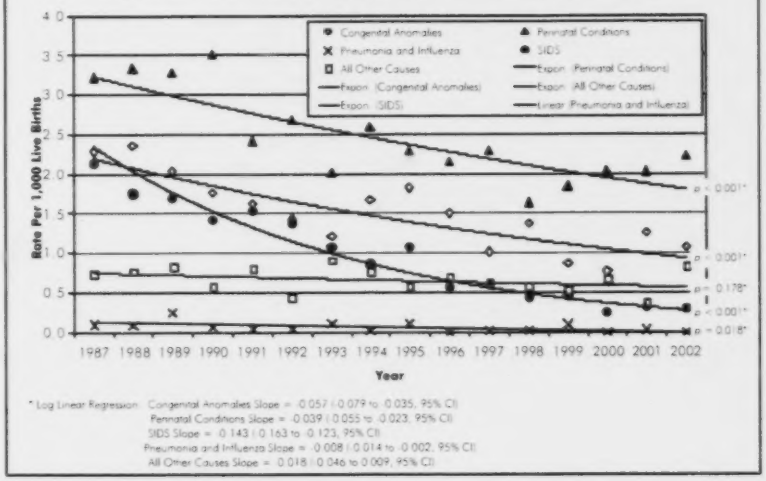
| Cause of Death | 1999-2000 | | | 2001-2002 | | | Statistically Significant Difference* |
|---|---|---|---|---|---|---|---|
| | Infant Deaths | Rate Per 10,000 Live Births | 95% C.I. | Infant Deaths | Rate Per 10,000 Live Births | 95% C.I. | |
| Perinatal conditions | | | | | | | |
| Infant affected by maternal factors | 55 | 6.69 | 5.02 to 8.69 | 65 | 8.10 | 6.25 to 10.29 | |
| Premature/postmature and fetal growth disorders | 16 | 1.95 | 1.11 to 3.15 | 31 | 3.86 | 2.62 to 5.48 | |
| Respiratory and cardiovascular disorders | 50 | 6.08 | 4.50 to 8.03 | 32 | 3.99 | 2.73 to 5.62 | |
| Hemorrhage and hematological disorders | 9 | 1.09 | 0.50 to 2.08 | 16 | 1.99 | 1.14 to 3.23 | |
| Other disorders originating in the perinatal period | 13 | 1.58 | 0.84 to 2.70 | 18 | 2.24 | 1.33 to 3.54 | |
| Total deaths due to perinatal conditions | 159 | 19.33 | 16.50 to 22.65 | 171 | 21.31 | 18.28 to 24.81 | |
| Congenital anomalies | | | | | | | |
| - of the nervous system | 9 | 1.09 | 0.50 to 2.08 | 15 | 1.87 | 1.05 to 3.08 | |
| - of the heart and circulatory system | 22 | 2.68 | 1.68 to 4.04 | 31 | 3.86 | 2.62 to 5.48 | |
| - of the respiratory system | 13 | 1.58 | 0.84 to 2.70 | 7 | 0.87 | 0.35 to 1.80 | |
| - of the musculoskeletal system | 4 | 0.49 | 0.13 to 1.25 | 10 | 1.25 | 0.60 to 2.29 | |
| Other and multiple system syndromes | 4 | 0.49 | 0.13 to 1.25 | 11 | 1.37 | 0.68 to 2.45 | |
| Chromosomal anomalies | 11 | 1.34 | 0.67 to 2.39 | 17 | 2.12 | 1.23 to 3.39 | |
| Total deaths due to congenital anomalies | 67 | 8.15 | 6.31 to 10.35 | 94 | 11.71 | 9.46 to 14.29 | |
| TOTAL | 308 | 37.45 | 33.44 to 41.94 | 339 | 42.24 | 37.91 to 47.04 | |

* Statistically significant at $p < 0.05$. No differences were statistically significant.

The long-term improvement in infant mortality has occurred due to statistically significant decreases in all major causes of death: perinatal conditions, congenital anomalies, SIDS, and pneumonia/influenza (see figure 15).

The average annual rate of decline since 1987 was 14.3 per cent for SIDS, 3.9 per cent for perinatal conditions, 5.7 per cent for congenital anomalies, and 0.8 per cent for pneumonia/influenza. There was no significant change in trend for "all other causes."

**Figure 15: Infant Mortality by Major Cause, B.C., 1987-2002**



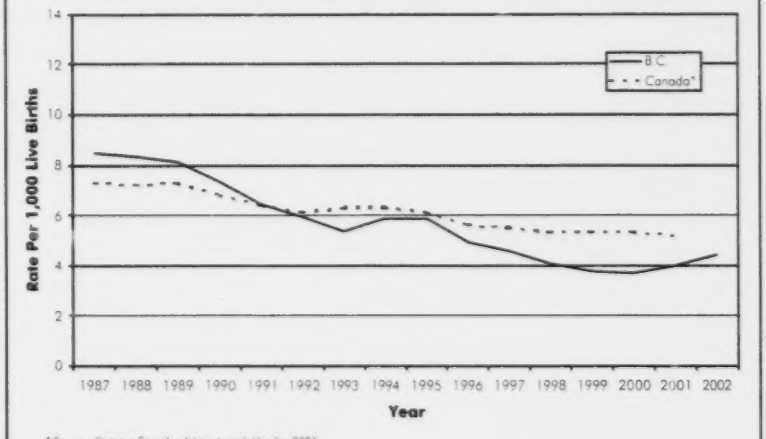

* Log Linear Regression: Congenital Anomalies Slope = -0.057 (-0.079 to -0.035, 95% CI)
Perinatal Conditions Slope = -0.039 (-0.055 to -0.023, 95% CI)
SIDS Slope = -0.143 (-0.163 to -0.123, 95% CI)
Pneumonia and Influenza Slope = -0.008 (-0.014 to -0.002, 95% CI)
All Other Causes Slope = -0.018 (-0.046 to 0.009, 95% CI)

## National and International Comparisons of Infant Mortality

To put the current provincial infant mortality rates into perspective, figure 16 shows the B.C. and national rates since 1987.

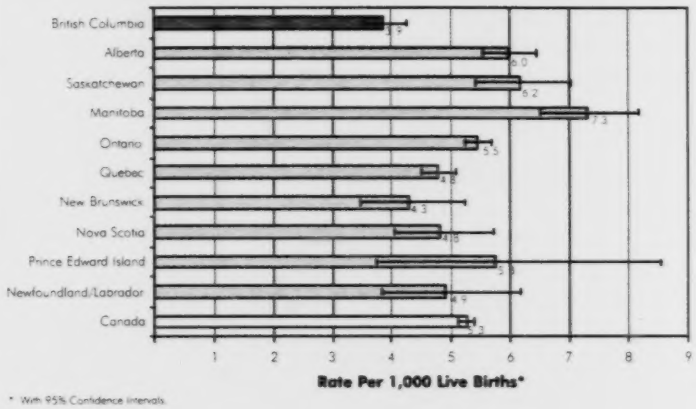
The B.C. rate was consistently lower than the national rate from 1992 to 2001 (the latest available national data), with both rates presenting an overall declining trend.

**Figure 16. Infant Mortality Rates, B.C. and Canada, 1987-2002**




* Source: Statistics Canada, data not available after 2001

**Figure 17. Infant Mortality Rates, by Province, Canada, 1999 to 2001**

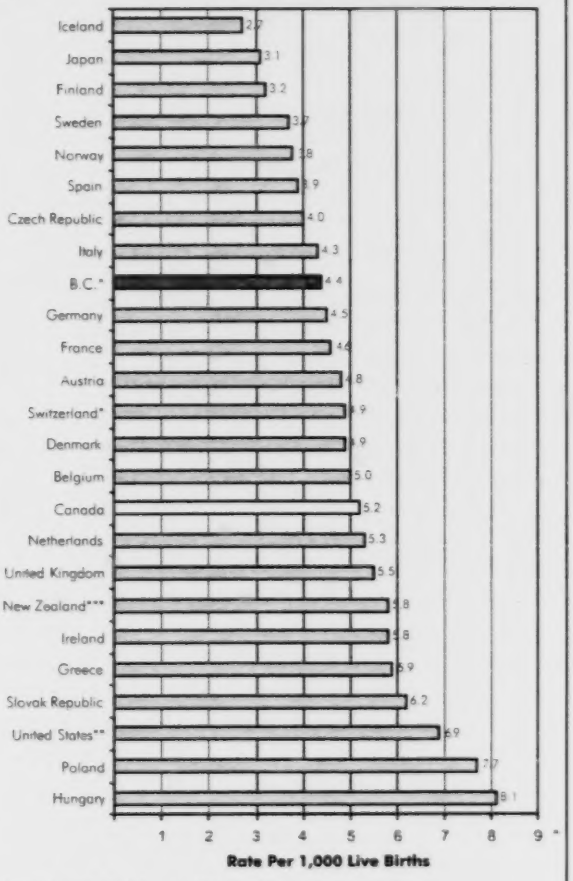



* With 95% Confidence Intervals.

Source: Statistics Canada.

Using three-year aggregate[9] national data from 1999 to 2001, B.C.'s infant mortality rate compares favourably to the Canadian average and the other provinces (see figure 17).

**Figure 18. Infant Mortality in Selected OECD Countries, 2001**




* Data are for 2002. The B.C. rate for 2001 was 4.0.
** Data are for 2000.
*** Data are for 1999.

Source: OECD (www.oecd.org).

International comparisons show that B.C. could potentially have better rates, as found in Japan and some European countries (see figure 18). Infant mortality rates below 3.5 per 1,000 are clearly attainable, as shown in statistics compiled by the Organization for Economic Cooperation and Development (OECD).

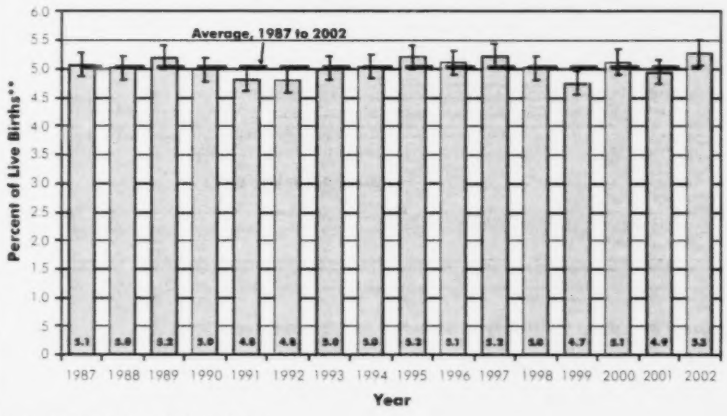
9. Three years of data provide a more stable basis of comparison, especially with the smaller provinces.

## Low Birth Weight

The next indicator of infant health to be examined was the LBW[10] rate, using the annual provincial rates for 1987 to 2002, and national and international comparisons for the most recent available years (see figures 19 to 21).

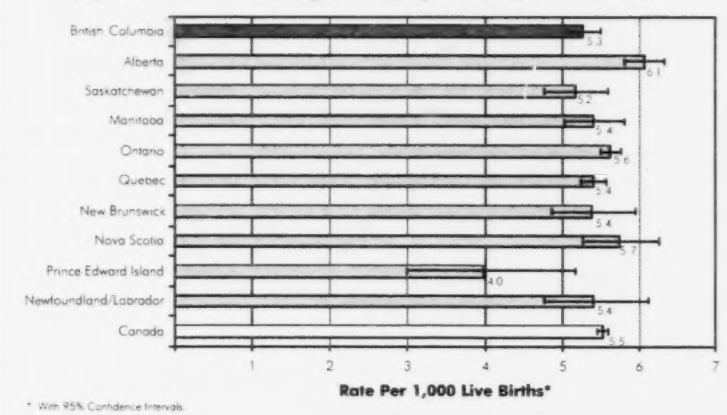
The data show that the LBW rate in B.C. has remained fairly stable at around 5 per cent over this prolonged period,[11] fluctuating between 4.7 and 5.3 per cent.

**Figure 19. Low Birth Weight* Rates, B.C., 1987 to 2002**



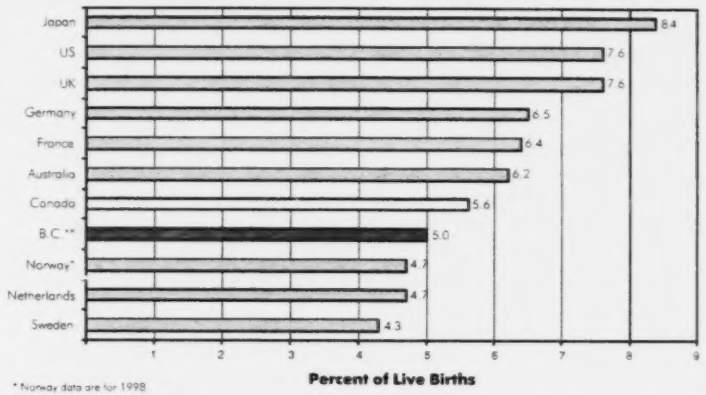

The B.C. rate was similar to that of other provinces, and in most cases the differences were not statistically significant.

**Figure 20. Low Birth Weight Rates, by Province, Canada, 2001**




10. Low birth weight baby – a newborn whose weight is less than 2,500 grams.
11. None of the 1999-2000 and 2001-2002 comparative differences in LBW rate were statistically significant for the province or any Health Authority, and no Health Authority rate differed significantly from the provincial average rate (see Appendix B).

**Figure 21. Low Birth Weight Rates, Selected OECD Countries, 1999**

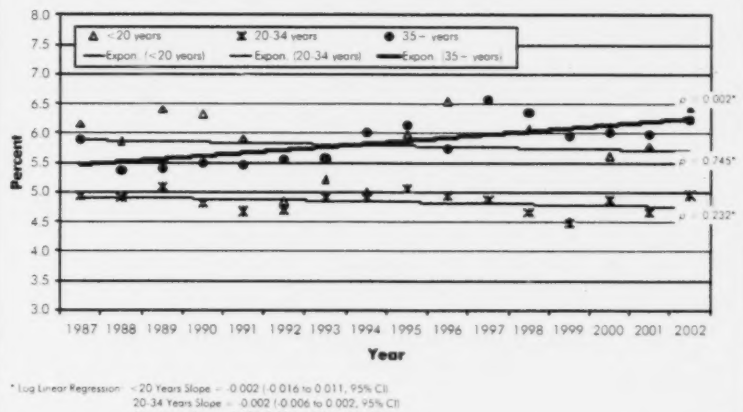



* Norway data are for 1998.
** B.C. data are long term average.

Source: EOCD, www.oecd.org

While B.C. compares favorably with many OECD countries[12], some have achieved lower LBW rates around 4.3 to 4.7 per cent, which suggests that improvement may be possible in B.C.

**Figure 22: LBW Rates by Maternal Age, B.C., 1987 to 2002**




* Log Linear Regression: <20 Years Slope = -0.002 (-0.016 to 0.011, 95% CI)
20-34 Years Slope = -0.002 (-0.006 to 0.002, 95% CI)
35+ Years Slope = 0.009 (0.004 to 0.014, 95% CI)

The LBW rate in B.C. was examined further by maternal age (see figure 22). This shows that the lowest rates occurred in mothers aged 20-34 years, with higher rates in both younger and older mothers.

However, the only maternal age group with a significant change over time was mothers aged 35+ years who experienced an increase in LBW, from 5.9 per cent in 1987 to 6.2 per cent in 2002.

The reasons need to be determined for the persistently higher LBW rate in teen mothers, and higher increasing rate in mothers aged 35+ years, in order to develop effective strategies for prevention in each age group. Although the data relating to this association are not shown in this analysis, over 90 per cent of LBW infants are preterm (<37 weeks), and similarly, over 90 per cent of preterm infants are LBW (<2500 grams). The fact that the LBW rate has not improved in B.C. over many years is a concern which will require further analysis. Contributing in part to this further study is a BCVSA[13] report (in press) which examines birth weight and gestational age in B.C. since 1981 and includes findings that babies born to immigrants of Chinese and south Asian origin had lower birth weights at all gestational ages. With significant immigration to B.C. from these areas over the last two decades, ethnic origin may need to be considered in the development and application of clinically appropriate birth weight standards. Also of interest is the increasing incidence of multiple births in mothers aged 35+ years, which is considered later in this paper.

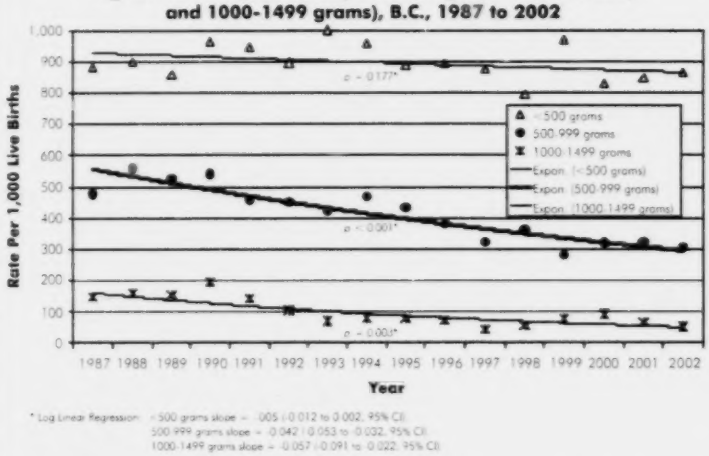
12. Japan is an anomaly, having a high LBW rate and low infant mortality rate.
13. W. Kierans et al, "Charting Birth Outcome in British Columbia: Determinants of Optimal Health and Ultimate Risk – An Expansion and Update", B.C. Vital Statistics Agency, In Press.

## Birth Weight and Infant Mortality

LBW is associated with multiple pregnancies, prematurity, and intrauterine growth retardation. As birth weight decreases, the infant mortality rate increases considerably, as shown in figures 23 and 24.

While the mortality for infants weighing less than 500 grams[14] has not significantly changed over time, mortality has significantly declined for all other weight categories of LBW and for infants weighing 2500 grams or more.

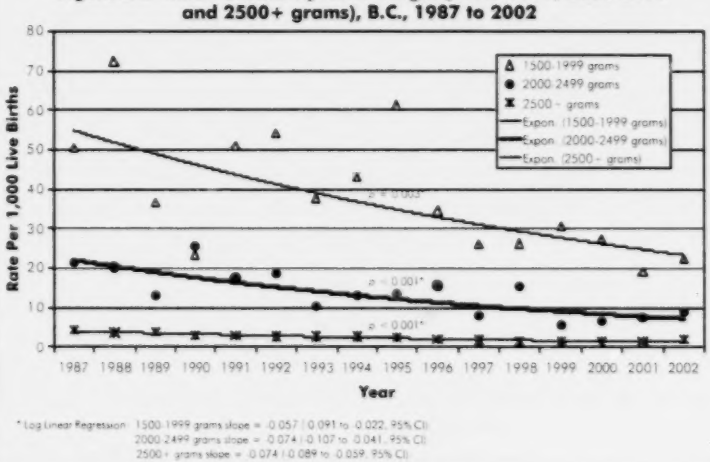
**Figure 23. Infant Deaths by Birth Weight (<500, 500-999, and 1000-1499 grams), B.C., 1987 to 2002**




* Log Linear Regression: <500 grams slope = -.005 (-0.012 to 0.002, 95% CI)
500-999 grams slope = -0.042 (-0.053 to -0.032, 95% CI)
1000-1499 grams slope = -0.057 (-0.091 to -0.022, 95% CI)

**[Note the difference in scale in these graphs.]**

**Figure 24. Infant Deaths by Birth Weight (1500-1999, 2000-2499 and 2500+ grams), B.C., 1987 to 2002**

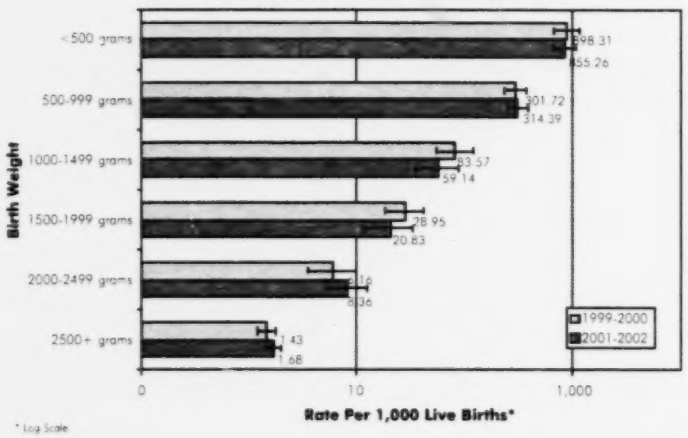



* Log Linear Regression: 1500-1999 grams slope = -0.057 (-0.091 to -0.022, 95% CI)
2000-2499 grams slope = -0.074 (-0.107 to -0.041, 95% CI)
2500+ grams slope = -0.074 (-0.089 to -0.059, 95% CI)

14. Note that the very high mortality rates for these infants mean that almost 9 out of 10 do not survive, and many of the survivors experience major health problems.

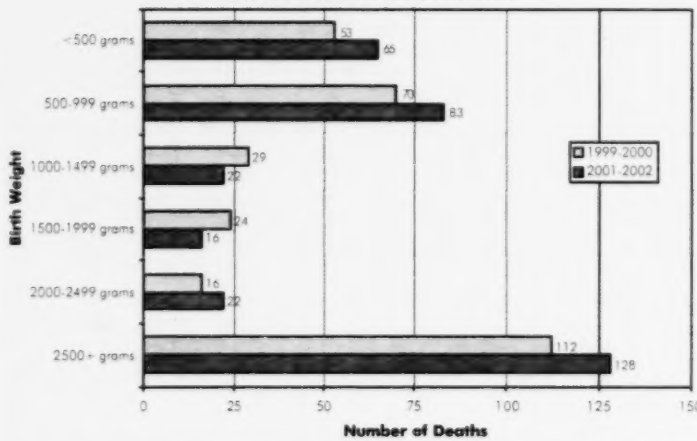
The different infant weight categories showed mixed patterns of mortality increase (500-999, 2000-2499, and 2500+ grams) or decrease (<500, 1000-1499, and 1500-1999 grams).

**Figure 25. Infant Mortality Rates by Birth Weight, B.C., 1999-2000 and 2001-2002**




However, none of the two-year comparative differences attained statistical significance (see figures 25 and 26).

**Figure 26. Infant Mortality by Birth Weight, B.C., 1999-2000 and 2001-2002**




In summary, the relationship between birth weight and infant mortality suggests that further long-term reductions in infant mortality will require improvement in the LBW rate.

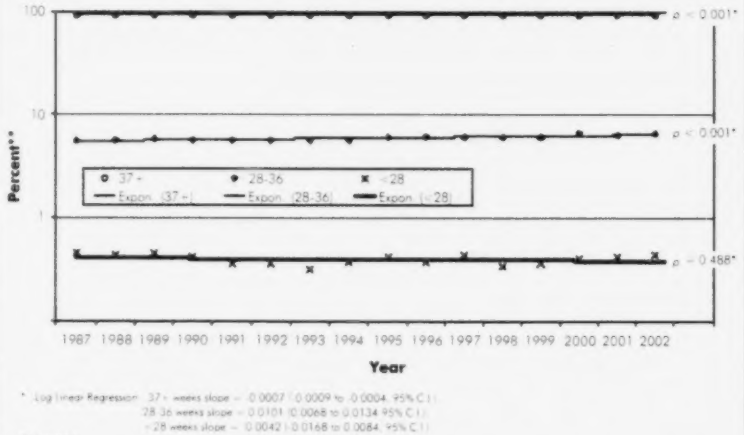
## Gestational Age and Infant Mortality

The proportion of births by gestational age has gradually changed over the last 16 years (see figure 27). The proportion of births has slightly increased for gestational age 28-36 weeks (from 5.6 per cent in 1987 to 6.6 per cent in 2002) and has slightly decreased for 37+ weeks over time. These changes are statistically significant.

**[Note that this next group of charts is in logarithm scale]**

However, the proportion of births <28 weeks (less than 1 per cent) has not changed significantly. The increasing proportion of pre-term births of 28 to 36 weeks over time warrants further analysis. This would include an examination of potential factors such as multiple births and maternal age.[15]

**Figure 27. Proportion of Births by Gestational Age, B.C., 1987 to 2002**

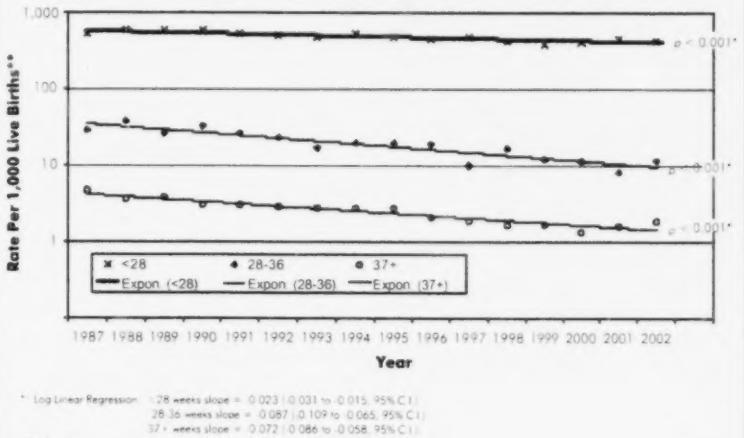



* Log Linear Regression: 37+ weeks slope = -0.0007 (-0.0009 to -0.0004, 95% CI);
28-36 weeks slope = 0.0101 (0.0068 to 0.0134 95% CI);
<28 weeks slope = -0.0042 (-0.0168 to 0.0084, 95% CI)

** Log scale

The mortality rates by gestational age show considerable increases as gestational age decreases (see figure 28). Over the last sixteen years, the mortality rates decreased for all gestational age categories shown. All declines were statistically significant.

**Figure 28. Infant Mortality by Gestational Age, B.C., 1987 to 2002**

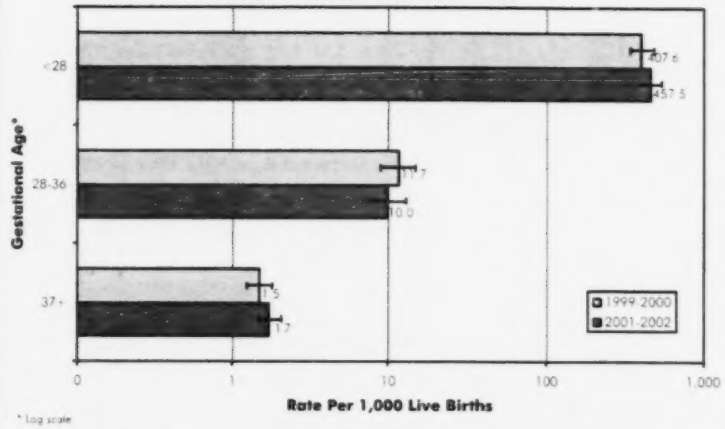



* Log Linear Regression: <28 weeks slope = -0.023 (-0.031 to -0.015, 95% CI);
28-36 weeks slope = -0.087 (-0.109 to -0.065, 95% CI);
37+ weeks slope = -0.072 (-0.086 to -0.058, 95% CI)

** Log scale

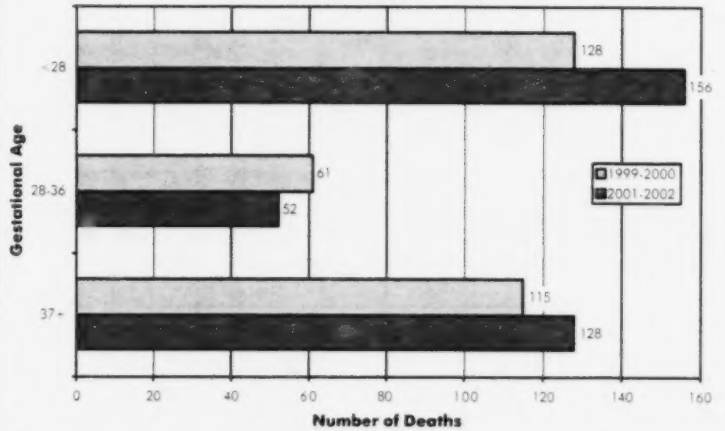
15. The overall proportion of preterm births (<37 weeks) has increased from 6.1 per cent in 1987 to 7.1 per cent in 2002, a change which was statistically significant, p<0.001, slope = 0.0092 (0.0055 to 0.0128, 95 per cent CI).

**Figure 29. Infant Mortality Rates by Gestational Age, B.C., 1999-2000 and 2001-2002**



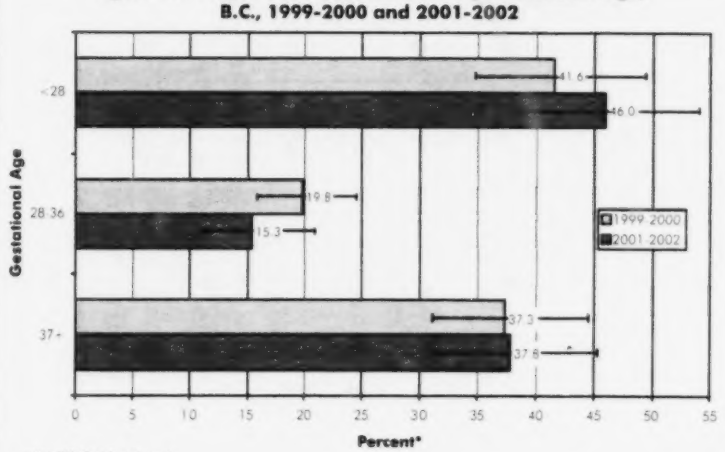

Examination of the two-year combined comparisons shows that there were offsetting differences in the number of deaths for gestational ages 28-36 and 37+ weeks (see figures 29 to 31).

**Figure 30. Infant Deaths by Gestational Age, B.C., 1999-2000 and 2001-2002**




There was a more substantial difference for <28 weeks in 2001-2002, an increase of 28 deaths. None of the differences in rates or proportions were statistically significant.

**Figure 31. Proportion of Infant Deaths by Gestational Age, B.C., 1999-2000 and 2001-2002**



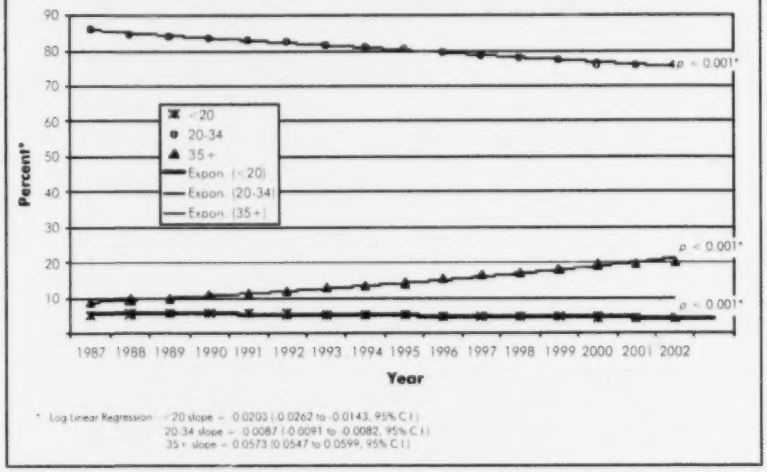

In summary, the relationship between gestational age and infant mortality suggests that further long-term reductions in infant mortality will require a reversal of the gradually increasing 28-36 weeks preterm birth rate and a decrease in the persistent <28 weeks preterm birth rate.

## Maternal Age and Infant Mortality

The proportion of births by maternal age has significantly changed over time.

There has been a decrease in the proportion of births to mothers aged <20 and 20-34 years, and an increase to mothers aged 35+ years (see figure 32).

**Figure 32. Proportion of Births by Maternal Age, B.C., 1987 to 2002**




The infant mortality rate for each age category of mother has significantly decreased over time (see figure 33). The highest infant mortality rate was for mothers aged <20 years. The infant mortality rate for mothers aged 35+ years has been similar to that of mothers aged 20-34 years.

**Figure 33. Infant Mortality by Maternal Age, B.C., 1998 to 2002**

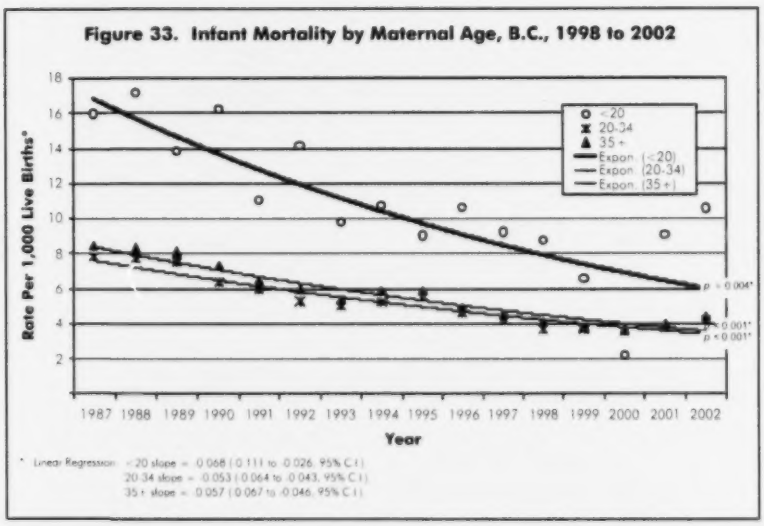
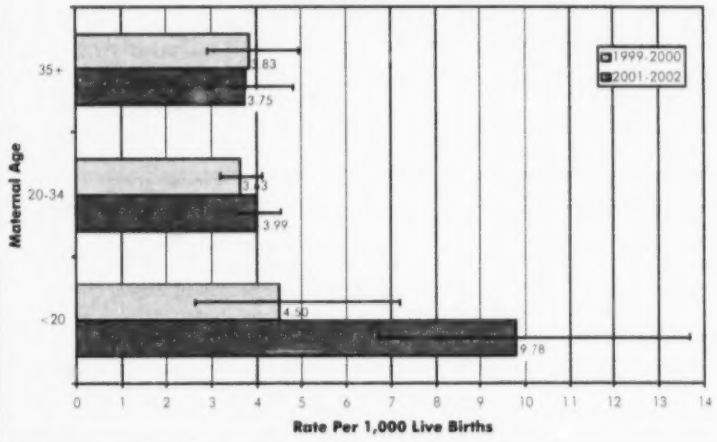
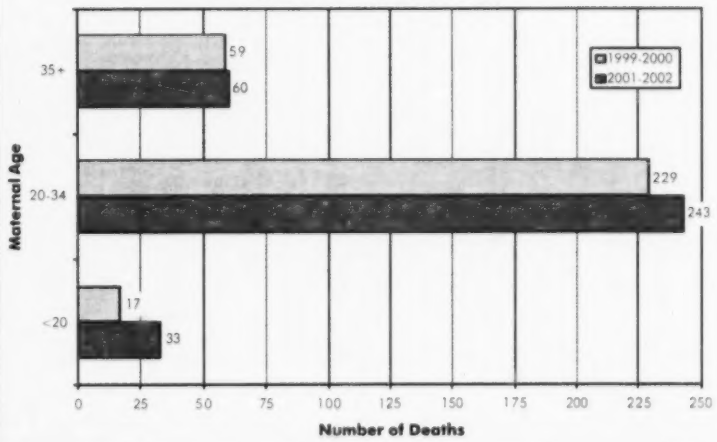


**Figure 34. Infant Mortality Rates by Maternal Age, B.C., 1999-2000 and 2001-2002**



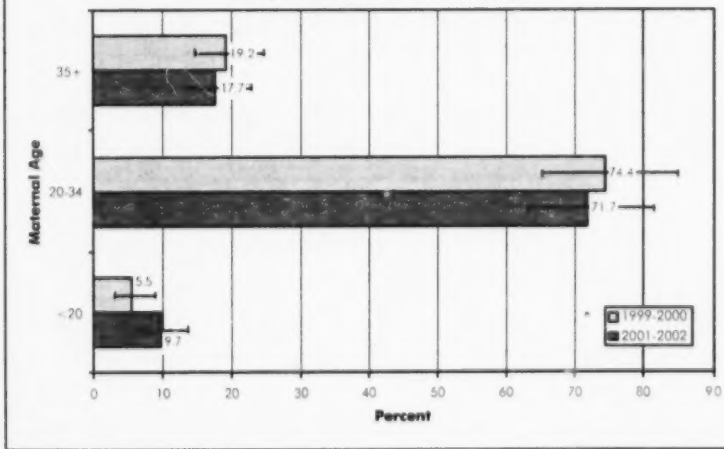

None of the two-year comparative differences by maternal age were statistically significant. However, a substantial drop in the infant mortality rate for mothers aged <20 years in 2000 (an anomalous fluctuation) and subsequent rise in 2001 and 2002, resulted in the combined year comparison showing a major increase in rate for the latter two years (see figures 34, 35, and 36).

**Figure 35. Infant Mortality by Maternal Age, B.C., 1999-2000 and 2001-2002**




While the numbers were relatively small and unstable, the infant mortality for mothers aged <20 years requires monitoring in case future fluctuation in rates affects the trend. However, it must be acknowledged that teen mothers, while at higher risk, comprised only 4.0 per cent of all mothers in 2002, and experienced 9.6 per cent of infant deaths in that year.

**Figure 36. Proportion of Infant Deaths by Maternal Age, B.C., 1999-2000 and 2001-2002**

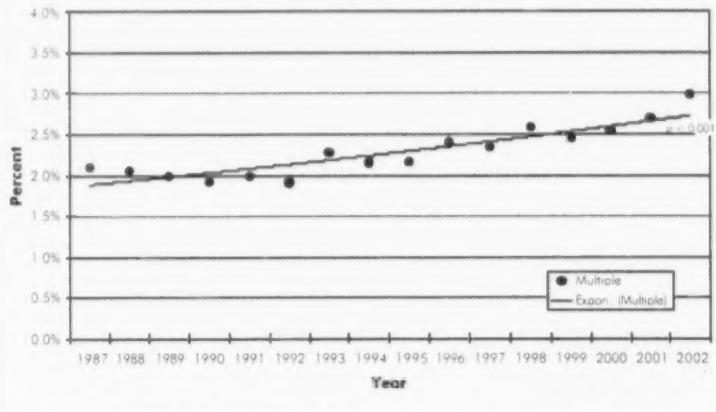



Thus, even if unintended teen pregnancy could be completely prevented, only a modest impact on infant mortality could be expected. In summary, the relationship between maternal age and infant mortality suggests that further long-term reductions in infant mortality require continuing attention to the issue of teen pregnancy.

## Multiple Births

Multiple births are associated with decreased gestational age and lower birth weights. The increasing proportion of multiple births, from 2.1 per cent in 1987 to 3.0 per cent in 2002, is statistically significant (see figure 37).

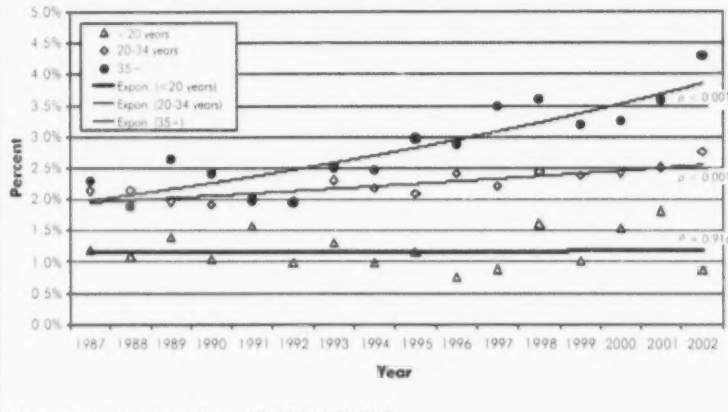
**Figure 37: Multiple Births as a Proportion of All Births, B.C., 1987 to 2002**




* Log Linear Regression: Slope = 0.025 (0.018 to 0.032, 95% CI)

However, the changing incidence of multiple births varies by maternal age, with the greatest increase in mothers aged >35 years, followed by mothers aged 20-34 years (see figure 38).

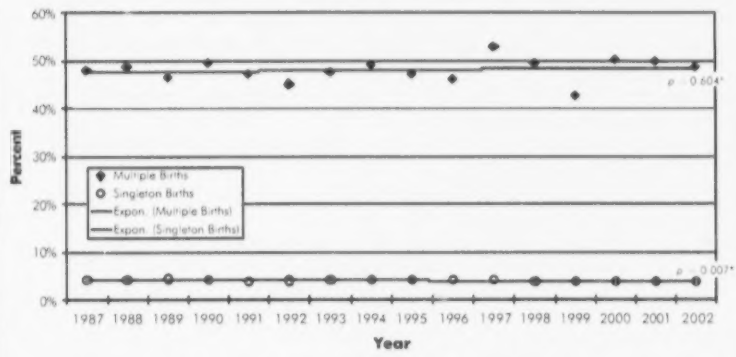
**Figure 38: Percent Multiple Births by Maternal Age, B.C., 1987 to 2002**




* Log Linear Regression: <20 Years Slope = -0.002 (-0.029 to 0.032, 95% CI)
20-34 Years Slope = 0.018 (0.011 to 0.025, 95% CI)
35+ Years Slope = 0.044 (0.030 to 0.059, 95% CI)

These increases (both statistically significant) are believed to be associated with infertility treatment, although data required to assess this issue were not available in time to be included in this report. There was no change in trend for mothers aged <20 years.

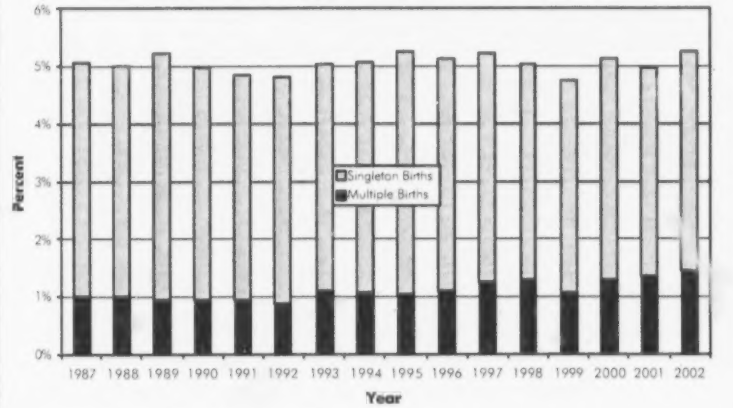
**Figure 39: Low Birth Weight Rates, Singleton and Multiple Births, B.C., 1987 to 2002**




* Log Linear Regression: Singleton Births Slope = -0.006 (-0.010 to -0.002, 95% CI)
Multiple Births Slope = 0.001 (-0.004 to 0.007, 95% CI)

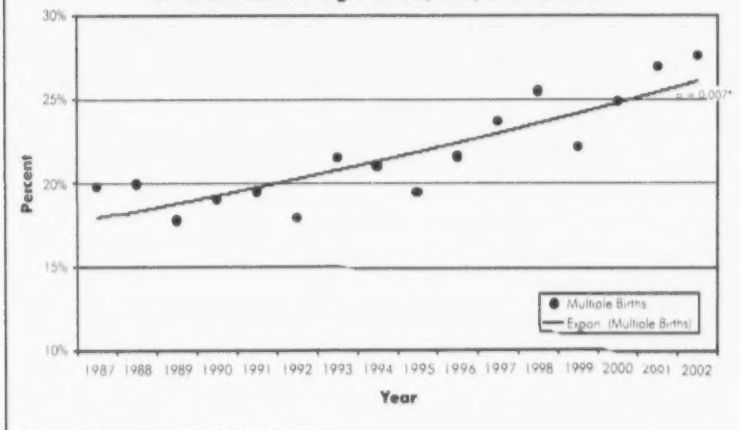
The LBW rate for multiple births has averaged 48.2 per cent, which is much higher than the average of 4.0 per cent for singleton births (see figure 39). The LBW rate for singleton births has slightly but significantly decreased from 4.2 per cent in 1987 to 3.9 per cent in 2002, while the LBW rate for multiple births has not significantly changed over this time.

**Figure 40: The Contribution of Singleton and Multiple Births to Low Birth Weight Rates, B.C., 1987 to 2002**




The increasing rate of multiple births, together with their high LBW rate, has resulted in multiple births constituting an increasingly higher number and proportion of all LBW births in the province (see figures 40 and 41, which appears to be offsetting the effect of the slight decline in LBW among singleton births.

**Figure 41: Low Birth Weight Multiple Births as a Proportion of All Low Birth Weight Births, B.C., 1987 to 2002**

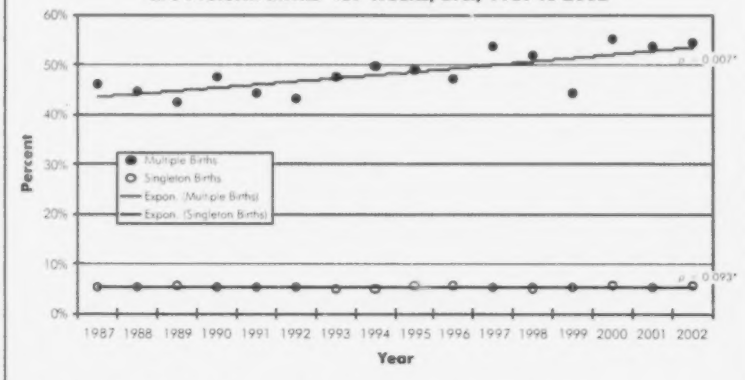



* Log Linear Regression: Slope = 0.025 (0.017 to 0.034, 95% CI)

The proportion of LBW associated with multiple births increased from 19.8 per cent in 1987 to 27.6 per cent in 2002, a change which was statistically significant.

Multiple births are increasingly more likely to be preterm births, from 46.1 per cent in 1987 to 54.5 per cent in 2002), a change which was statistically significant (see figure 42). The proportion of singletons which were preterm has not significantly changed over this time.

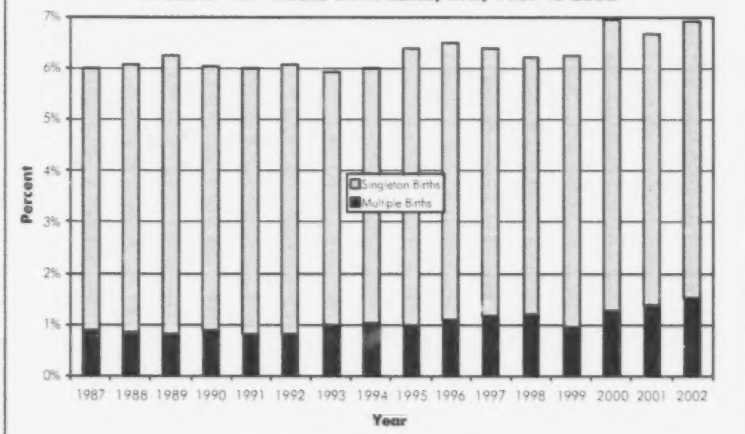
**Figure 42: Proportion of Singleton and Multiple Births which are Preterm Births <37 Weeks, B.C., 1987 to 2002**




* Log Linear Regression: Singleton Births Slope = 0.003 (-0.001 to 0.008, 95% CI)
Multiple Births Slope = 0.014 (0.007 to 0.021).

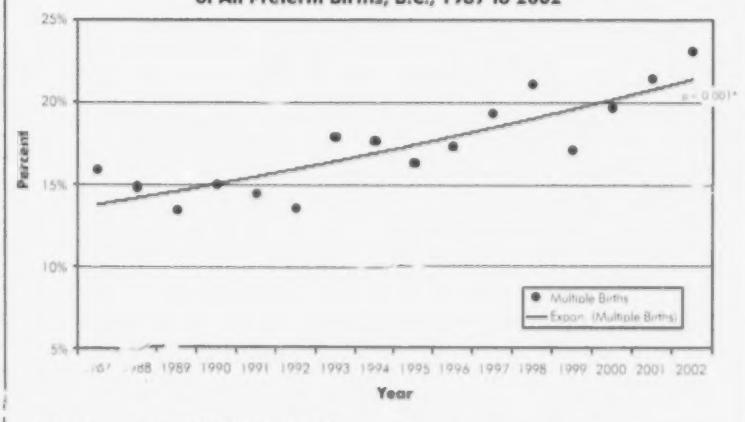
The effect of increased multiple births, together with an increasing proportion of multiple births being preterm, has resulted in multiple births constituting a higher proportion of all preterm births in the province (see figures 43 and 44).

**Figure 43: The Contribution of Singleton and Multiple Births to Preterm <37 Weeks Birth Rates, B.C., 1987 to 2002**



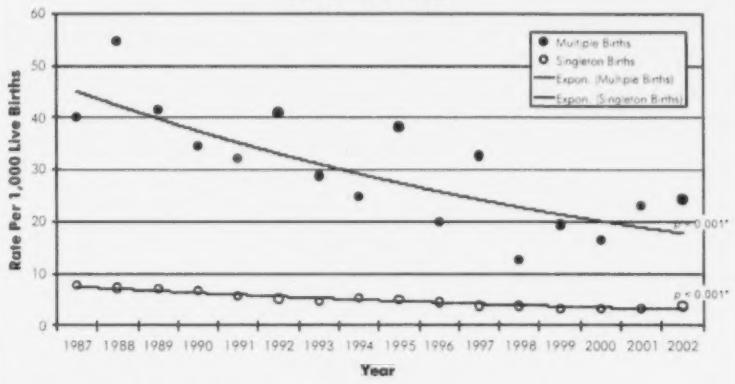

The proportion of preterm (<37 weeks) births associated with multiple births increased from 15.9 per cent in 1987 to 23.1 per cent in 2002, a change which was statistically significant.

**Figure 44: Preterm <37 Weeks Multiple Births as a Proportion of All Preterm Births, B.C., 1987 to 2002**




* Log Linear Regression: Slope = 0.029 (0.019 to 0.040, 95% CI)

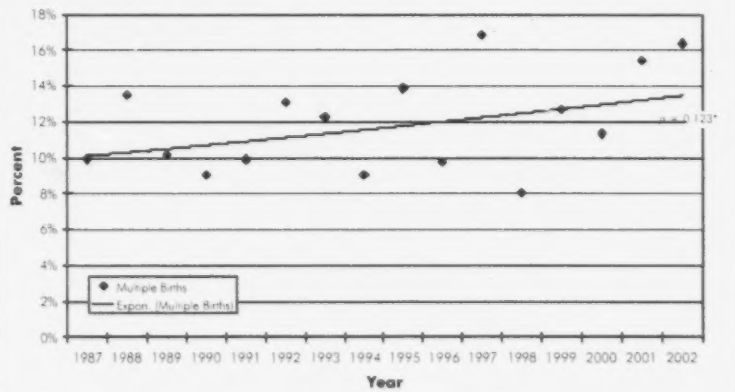
**Figure 45: Infant Death Rates, Singleton and Multiple Births, B.C., 1987 to 2002**




* Log Linear Regression: Singleton Births Slope = -0.058 (-0.069 to -0.048, 95% CI)
Multiple Births Slope = -0.062 (-0.093 to -0.032)

The infant mortality rate for multiple births is much higher than for singleton births. Rates for both have been significantly declining over time (see figure 45), with the average annual rate of decrease being greater for multiple births (6.2%) than for singletons (5.8%).

**Figure 46: Proportion of Infant Deaths, Multiple Births, B.C., 1987 to 2002**




* Log Linear Regression: Slope = 0.019 (-0.006 to 0.044, 95% CI)

The increasing proportion and higher mortality of multiple births, means that multiple births appear to account for a greater proportion of all infant deaths, increasing from 9.9 per cent in 1987 to 16.4 per cent in 2002 (see figure 46). However, because of small numbers and substantial annual fluctuation, this change was not statistically significant.

In summary, it appears that multiple births are an increasingly important factor in the analysis and interpretation of LBW, pre-term births, and infant mortality in the provincial population. A related issue is the possible association with infertility treatment in the B.C. population, which will be assessed later as a follow-up to this report.

## Summary of Infant and Perinatal Indicators

Over the last 16 years, there have been significant declines in overall infant mortality, neonatal mortality, post-neonatal mortality, perinatal mortality, infant mortality by gestational age, and infant mortality by birth weight (except for infants <500 grams). However, in contrast, over the same period of time there have been fairly constant stillbirth rates and LBW rates. There have also been significant gradual increases in the proportion of preterm births, the proportion of births to mother aged 35 years and older, and the proportion of multiple births. There has been a significant decrease in the proportion of teen mothers.

The differences in provincial annual rates for the two-year comparison periods (1999-2000 and 2001-2002) were not statistically significant for any of the following indicators of infant health:

- Infant Mortality
- Neonatal Mortality
- Early Neonatal Mortality
- Late Neonatal Mortality
- Post-Neonatal Mortality
- Stillbirth Rate
- Perinatal Mortality
- Low Birth Weight
- Infant Mortality by Gestational Age
- Infant Mortality by Maternal Age
- Infant Mortality by Birth Weight
- Infant Mortality due to Congenital Anomalies
- Infant Mortality due to Perinatal Conditions
- SIDS Rate

## Infants of Less Than 28 Weeks and 1500 Grams

While none of the mortality differences between the paired-year comparison periods were statistically significant, there remains an increased number of infant deaths in the last two years. Further details on live births and infant deaths by gestational age and birth weight are contained in table E, and an analysis of the excess infant deaths occurring in 2001-2002 was undertaken. None of the mortality rate differences by gestational age or birth weight between comparison periods were statistically significant.

**Table E: Live Births and Infant Mortality by Gestational Age and Birth Weight, B.C.**

**1999-2000**

**Number of Live Births**

| Gestational Age (in Weeks) | Birth Weight (in Grams) <1500 | 1500-2499 | 2500+ | N.S. | Total Number |
|---|---|---|---|---|---|
| <28 | 310 | 4 | - | - | 314 |
| 28-36 | 325 | 2,305 | 2,588 | - | 5,218 |
| 37+ | 3 | 1,117 | 75,548 | - | 76,668 |
| N.S. | - | - | 1 | 40 | 41 |
| TOTAL | 638 | 3,426 | 78,137 | 40 | 82,241 |

**Percent of Live Births**

| Gestational Age (in Weeks) | Birth Weight (in Grams) <1500 | 1500-2499 | 2500+ | N.S. | Total Number |
|---|---|---|---|---|---|
| <28 | 0.4% | 0.0% | 0.0% | 0.0% | 0.4% |
| 28-36 | 0.4% | 2.8% | 3.1% | 0.0% | 6.3% |
| 37+ | 0.0% | 1.4% | 91.9% | 0.0% | 93.2% |
| N.S. | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| TOTAL | 0.8% | 4.2% | 95.0% | 0.0% | 100.0% |

**Number of Infant Deaths**

| Gestational Age (in Weeks) | Birth Weight (in Grams) <1500 | 1500-2499 | 2500+ | N.S. | Total Number |
|---|---|---|---|---|---|
| <28 | 127 | 1 | - | - | 128 |
| 28-36 | 24 | 27 | 10 | - | 61 |
| 37+ | 1 | 12 | 102 | - | 115 |
| N.S. | - | - | - | 4 | 4 |
| TOTAL | 152 | 40 | 112 | 4 | 308 |

**Percent of Infant Deaths**

| Gestational Age (in Weeks) | Birth Weight (in Grams) <1500 | 1500-2499 | 2500+ | N.S. | Total Number |
|---|---|---|---|---|---|
| <28 | 41.2% | 0.3% | 0.0% | 0.0% | 41.6% |
| 28-36 | 7.8% | 8.8% | 3.2% | 0.0% | 19.8% |
| 37+ | 0.3% | 3.9% | 33.1% | 0.0% | 37.3% |
| N.S. | 0.0% | 0.0% | 0.0% | 1.3% | 1.3% |
| TOTAL | 49.4% | 13.0% | 36.3% | 1.3% | 100.0% |

**Infant Mortality Rates Per 1,000**

| Gestational Age (in Weeks) | Birth Weight (in Grams) <1500 | 1500-2499 | 2500+ | N.S. | Total Number |
|---|---|---|---|---|---|
| <28 | 409.7 | * | * | * | 407.6 |
| 28-36 | 73.8 | 11.7 | 3.9 | * | 11.7 |
| 37+ | * | 10.7 | 1.4 | * | 1.5 |
| N.S. | * | * | * | * | * |
| TOTAL | 238.2 | 11.7 | 1.4 | * | 3.7 |

* Rates based on <5 or 0 deaths not shown.

**Infant Mortality Rates (95% CI)**

| Gestational Age (in Weeks) | Birth Weight (in Grams) <1500 | 1500-2499 | 2500+ | N.S. | Total Number |
|---|---|---|---|---|---|
| <28 | 342.9 to 489.1 | - | - | - | 341.4 to 486.4 |
| 28-36 | 47.3 to 110.0 | 7.7 to 17.0 | 1.9 to 7.1 | - | 8.9 to 15.0 |
| 37+ | - | 5.6 to 18.8 | 1.1 to 1.6 | - | 1.2 to 1.8 |
| TOTAL | 202.5 to 280.1 | 8.3 to 15.9 | 1.2 to 1.7 | - | 3.3 to 4.2 |

**2001-2002**

**Number of Live Births**

| Gestational Age (in Weeks) | Birth Weight (in Grams) <1500 | 1500-2499 | 2500+ | N.S. | Total Number |
|---|---|---|---|---|---|
| <28 | 336 | 4 | 1 | - | 341 |
| 28-36 | 370 | 2,221 | 2,599 | - | 5,190 |
| 37+ | 6 | 1,175 | 73,472 | - | 74,653 |
| N.S. | - | - | - | 100 | 100 |
| TOTAL | 712 | 3,400 | 76,072 | 100 | 80,284 |

**Percent of Live Births**

| Gestational Age (in Weeks) | Birth Weight (in Grams) <1500 | 1500-2499 | 2500+ | N.S. | Total Number |
|---|---|---|---|---|---|
| <28 | 0.4% | 0.0% | 0.0% | 0.0% | 0.4% |
| 28-36 | 0.5% | 2.8% | 3.2% | 0.0% | 6.5% |
| 37+ | 0.0% | 1.5% | 91.5% | 0.0% | 93.0% |
| N.S. | 0.0% | 0.0% | 0.0% | 0.1% | 0.1% |
| TOTAL | 0.9% | 4.2% | 92.5% | 0.1% | 97.6% |

**Number of Infant Deaths**

| Gestational Age (in Weeks) | Birth Weight (in Grams) <1500 | 1500-2499 | 2500+ | N.S. | Total Number |
|---|---|---|---|---|---|
| <28 | 154 | 1 | 1 | - | 156 |
| 28-36 | 15 | 22 | 15 | - | 52 |
| 37+ | 1 | 15 | 112 | - | 128 |
| N.S. | 0 | - | - | 3 | 3 |
| TOTAL | 170 | 38 | 128 | 3 | 339 |

**Percent of Infant Deaths**

| Gestational Age (in Weeks) | Birth Weight (in Grams) <1500 | 1500-2499 | 2500+ | N.S. | Total Number |
|---|---|---|---|---|---|
| <28 | 45.4% | 0.3% | 0.3% | 0.0% | 46.0% |
| 28-36 | 4.4% | 6.5% | 4.4% | 0.0% | 15.3% |
| 37+ | 0.3% | 4.4% | 33.0% | 0.0% | 37.8% |
| N.S. | 0.0% | 0.0% | 0.0% | 0.9% | 0.9% |
| TOTAL | 50.1% | 11.2% | 37.8% | 0.9% | 100.0% |

**Infant Mortality Rates Per 1,000**

| Gestational Age (in Weeks) | Birth Weight (in Grams) <1500 | 1500-2499 | 2500+ | N.S. | Total Number |
|---|---|---|---|---|---|
| <28 | 458.3 | * | * | * | 457.5 |
| 28-36 | 40.5 | 9.9 | 5.8 | * | 10.0 |
| 37+ | * | 12.8 | 1.5 | * | 1.7 |
| N.S. | * | * | * | * | * |
| TOTAL | 238.8 | 11.2 | 1.7 | * | 4.2 |

* Rates based on <5 or 0 deaths not shown.

**Infant Mortality Rates (95% CI)**

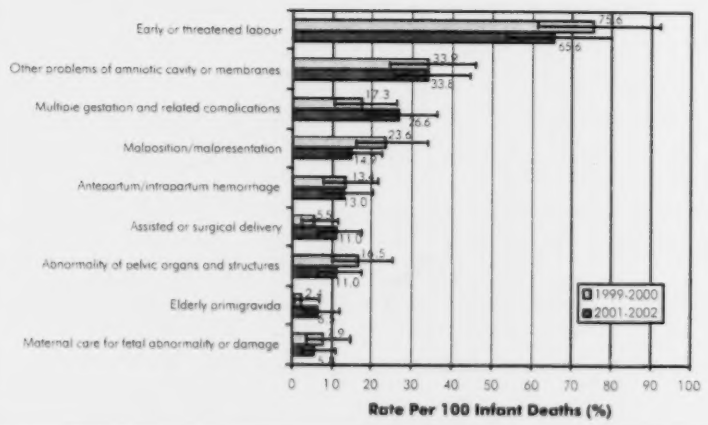
| Gestational Age (in Weeks) | Birth Weight (in Grams) <1500 | 1500-2499 | 2500+ | N.S. | Total Number |
|---|---|---|---|---|---|
| <28 | 390.1 to 538.3 | - | - | - | 389.7 to 536.7 |
| 28-36 | 22.7 to 66.9 | 6.2 to 15.0 | 3.2 to 9.5 | - | 7.5 to 13.1 |
| 37+ | - | - | 1.3 to 1.8 | - | 1.4 to 2.0 |
| TOTAL | 204.8 to 276.2 | 7.9 to 15.3 | 1.4 to 2.0 | - | 3.8 to 4.7 |

Of particular interest is the group of infants with the highest mortality, babies of birth weight <1,500 grams and gestational age <28 weeks. In 2001-2002, there were 336 such infants and 154 deaths, while in 1999-2000, there were 310 such infants and 127 deaths. The mortality rates were not significantly different (458 and 410 per 1,000) between the comparison periods, but this fragile group of infants accounted for 27 of the 31 increased deaths in 2001-2002. There were also differences in the numbers of deaths in the other gestational age/ birth weight categories, although the numbers were smaller (see Table F). A more detailed assessment of the effect of birth weight and gestational age on Relative Risk of mortality is shown in Appendix D.

**Table F: Increase (Decrease) in Infant Deaths in 2001-2002 As Compared with 1999-2000**

| Gestational Age (in Weeks) | Birth Weight (in Grams) | | | | Total Number |
|---|---|---|---|---|---|
| | <1500 | 1500-2499 | 2500+ | N.S. | |
| <28 | 27 | 0 | 1 | 0 | 28 |
| 28-36 | (9) | (5) | 5 | 0 | (9) |
| 37+ | 0 | 3 | 10 | 0 | 13 |
| N.S. | 0 | 0 | 0 | (1) | (1) |
| Total Number | 18 | (2) | 16 | (1) | 31 |

**Figure 47. Common Maternal Complications of Pregnancy and Delivery as a Proportion of Deaths of Infants of <1500 grams and <28 weeks, B.C., 1999-2002**

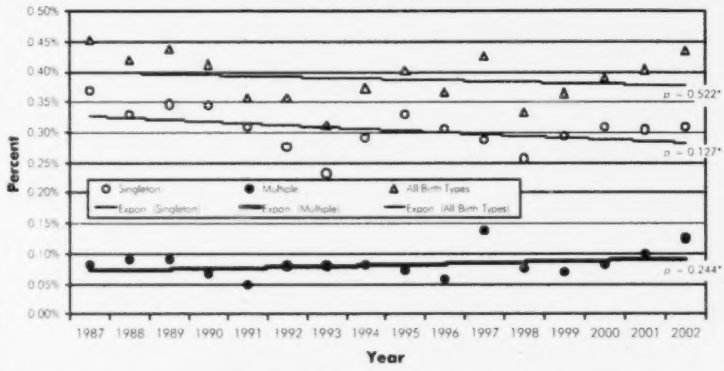

Early or threatened labour
Other problems of amniotic cavity or membranes
Multiple gestation and related complications
Malposition/malpresentation
Antepartum/intrapartum hemorrhage
Assisted or surgical delivery
Abnormality of pelvic organs and structures
Elderly primigravida
Maternal care for fetal abnormality or damage
1999-2000
2001-2002
0 10 20 30 40 50 60 70 80 90 100
Rate Per 100 Infant Deaths (%)

The more common maternal complications associated with these very high risk infants were examined next, specifically all categories of complication associated with ten or more infant deaths during the entire four-year period 1999-2002 (see figure 47). The sum of the percentage of complications exceeds 100 per cent, as many deceased cases experienced more than one maternal complication.

Overall, there were 2.1 complications per infant death in 1999-2000 and 2.0 in 2001/2002. None of the differences in proportion between the comparison periods attained statistical significance. By far the most frequent maternal complication (2/3 to 3/4 of cases) associated with the death of high-risk infants was "early or threatened labour." In the period 1999 to 2002, these high-risk infants accounted for 0.4 per cent of all live births and 43.4 per cent of all infant deaths.

Because of their major contribution to infant mortality, time trends on these <1,500 grams and <28 weeks infants were examined further by kind of birth. The proportion of all births that are <1,500 grams and <28 weeks has not significantly changed over time, whether for singleton or multiple births (see figure 48).

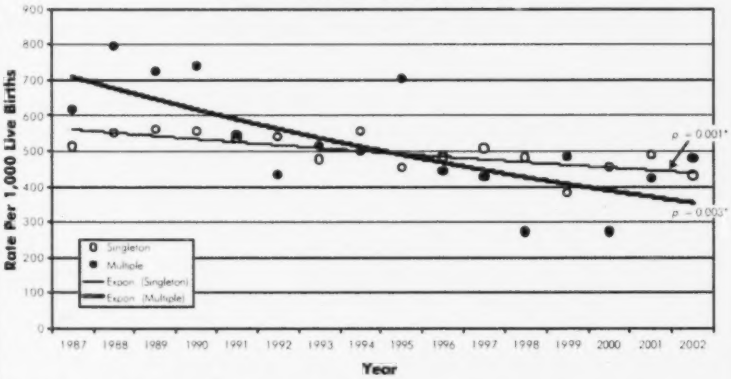
**Figure 48: Births of Infants <1500 grams and <28 weeks, by Kind of Birth, as a Percentage of All Live Births, B.C., 1987-2002**




* Log Linear Regression: Singleton Births Slope = -0.010 (-0.022 to 0.003, 95% CI)
Multiple Births Slope = 0.017 (-0.013 to 0.046, 95% CI)
All Births Slope = -0.004 (-0.016 to 0.009, 95% CI)

Infant mortality rates for these infants have significantly decreased over time, for both singleton and multiple births (see figure 49). While the line for all birth kinds was not graphed, the decline was also statistically significant ($p<0.001$).

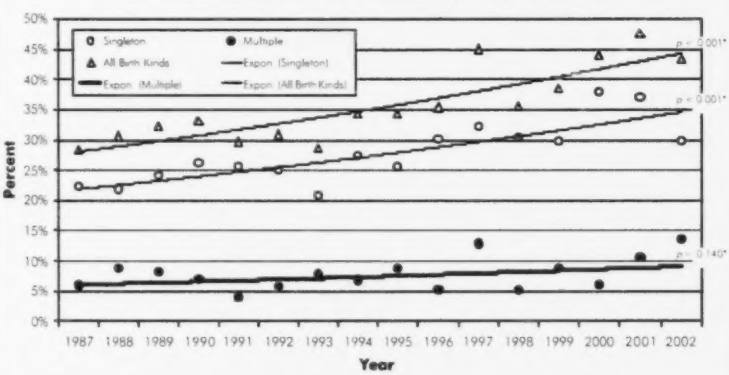
**Figure 49: Infant Mortality Rate by Kind of Birth, Infants <1500 grams and <28 weeks, B.C., 1987-2002**



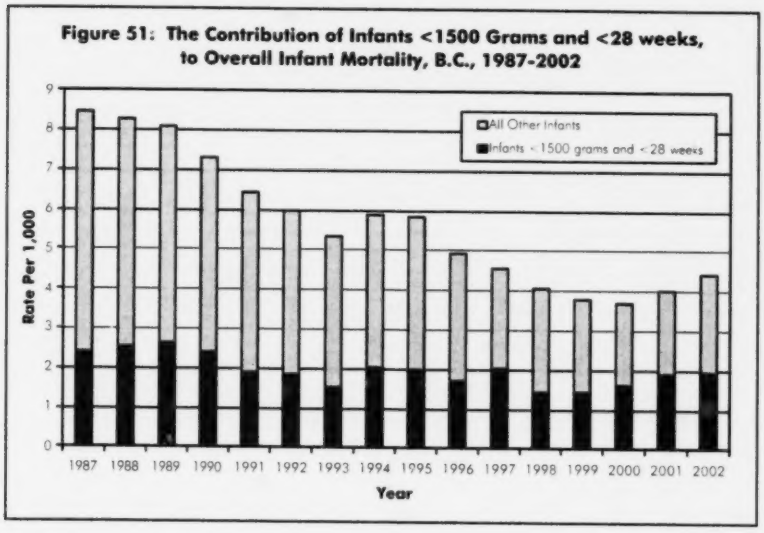

* Log Linear Regression: Singleton Births Slope = -0.016 (-0.025 to -0.007, 95% CI)
Multiple Births Slope = -0.046 (-0.073 to -0.019, 95% CI)
All Births Slope = -0.022 (-0.030 to -0.015, 95% CI)

However, when viewed by their contribution to the overall infant mortality experience, these high-risk infants (all birth kinds) accounted for 28 per cent of infant deaths in 1987 and increased to 44 per cent by 2002. The increasing trend was statistically significant for singletons and all birth kinds, but not for multiple births (see figure 50).

**Figure 50: Proportion of Infant Deaths, Infants <1500 grams and <28 weeks, as a Percentage of All Infant Deaths, B.C., 1987-2002**




* Log Linear Regression: Singleton Births Slope = 0.031 (0.019 to 0.042, 95% CI)
Multiple Births Slope = 0.027 (0.010 to 0.064, 95% CI)
All Births Slope = 0.030 (0.020 to 0.041, 95% CI)



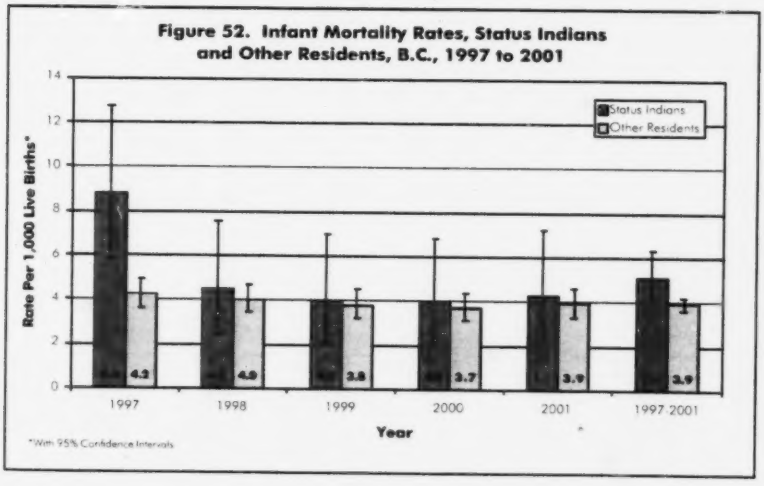

On presenting the same data as in the previous infant mortality graph (in figure 5), the mortality impact of these infants <1,500 grams and <28 weeks on the mortality rate for the entire provincial infant population is apparent (see figure 51).

As the mortality of other infants has improved over time, the persistent residual mortality effect of these high-risk infants is making a proportionately greater contribution to infant mortality in the population.

In summary, this limited analysis of infants <1,500 grams and <28 weeks is sufficient to demonstrate that this high-risk group constitutes an increasingly important component of the infant mortality picture. The nature and implications of this finding require further study, in order to develop appropriate and effective means of prevention to the extent which is reasonably practicable.

## Special Populations

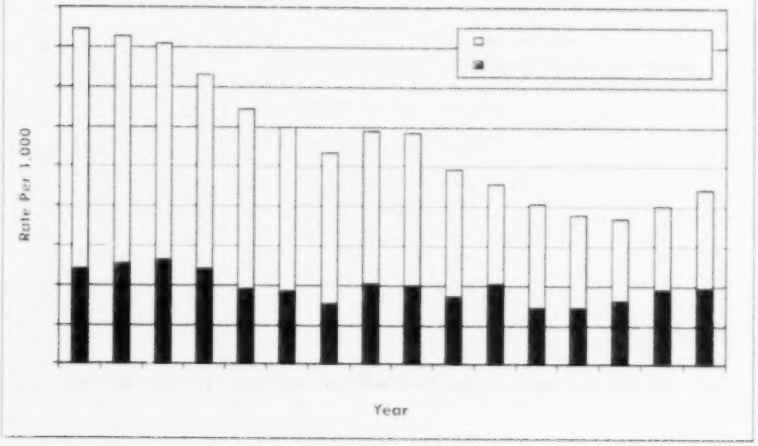
Some populations in B.C. are recognized as being at higher risk than others for poor health. One such group is the First Nations community. Status Indian infant mortality data were examined for the five-year period ending in 2001.[16]




While infant mortality was higher for Status Indians compared with other B.C. residents for each of the last five years (see figure 52), the only statistically significant difference was for 1997. The difference for the five-year combined comparison was influenced by the higher rate in 1997, and was not quite large enough to attain statistical significance.

16. Data for 2002 were not available in time to be included in this report. Only data for Status Indians were analyzed, as comparable data are lacking for other First Nations people.

**Figure 51: The Contribution of Infants <1500 Grams and <28 weeks, to Overall Infant Mortality, B.C., 1987-2002**




On presenting the same data as in the previous infant mortality graph (in figure 5), the mortality impact of these infants <1,500 grams and <28 weeks on the mortality rate for the entire provincial infant population is apparent (see figure 51).

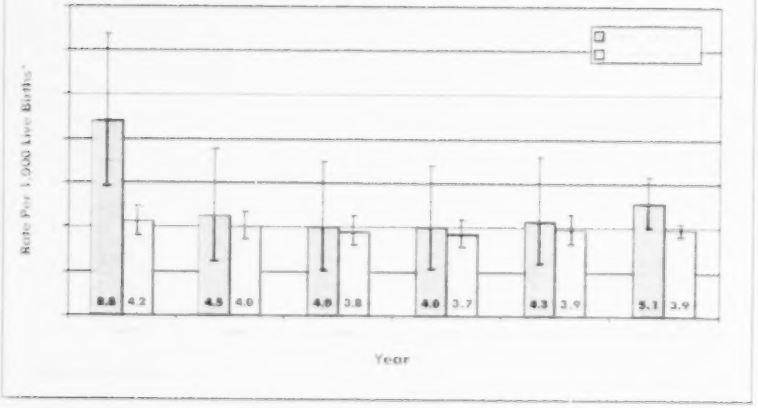
As the mortality of other infants has improved over time, the persistent residual mortality effect of these high-risk infants is making a proportionately greater contribution to infant mortality in the population.

In summary, this limited analysis of infants <1,500 grams and <28 weeks is sufficient to demonstrate that this high-risk group constitutes an increasingly important component of the infant mortality picture. The nature and implications of this finding require further study, in order to develop appropriate and effective means of prevention to the extent which is reasonably practicable.

## Special Populations

Some populations in B.C. are recognized as being at higher risk than others for poor health. One such group is the First Nations community. Status Indian infant mortality data were examined for the five-year period ending in 2001.[16]

**Figure 52. Infant Mortality Rates, Status Indians and Other Residents, B.C., 1997 to 2001**

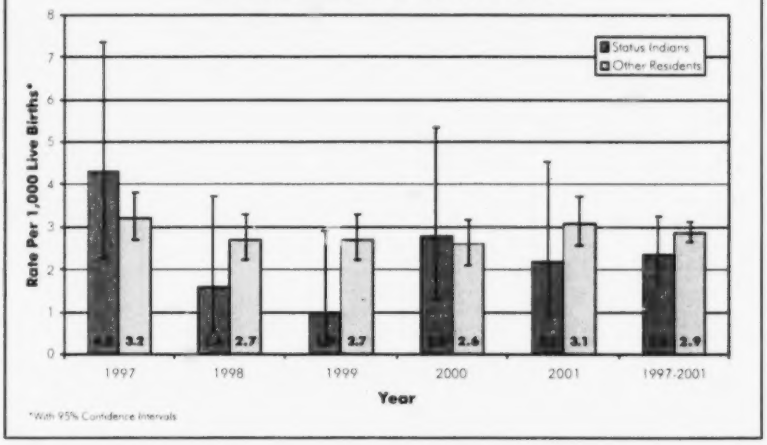



While infant mortality was higher for Status Indians compared with other B.C. residents for each of the last five years (see figure 52), the only statistically significant difference was for 1997. The difference for the five-year combined comparison was influenced by the higher rate in 1997, and was not quite large enough to attain statistical significance.

16: Data for 2002 were not available in time to be included in this report. Only data for Status Indians were analyzed, as comparable data are lacking for other First Nations people.

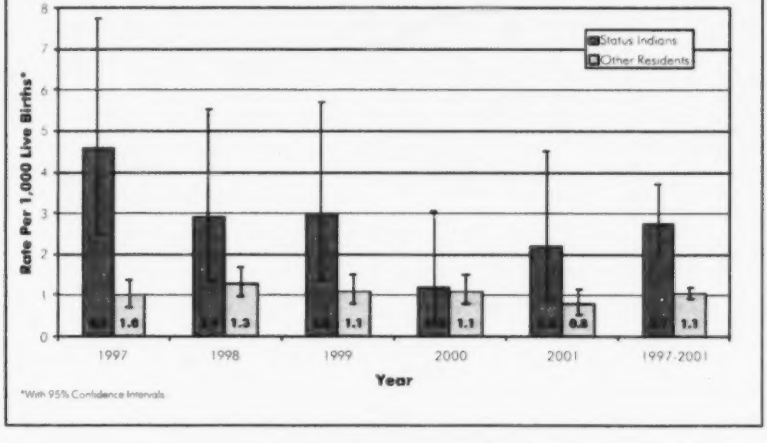
Neonatal mortality showed more annual fluctuation (due to small numbers) for Status Indians, but was generally lower than for other B.C. residents (see figure 53). However, the differences were not statistically significant for any individual year or for the five-year combined comparison.

**Figure 53. Neonatal Mortality Rates, Status Indians and Other Residents, B.C., 1997 to 2001**




However, post-neonatal mortality was generally much higher for Status Indians - over twice the mortality of other residents (see figure 54). The differences for 1997 and the combined five-year comparisons were statistically significant. This disparity was previously noted in the Provincial Health Officer's 2001 Annual Report on Aboriginal Health and Well-Being.

**Figure 54: Post-Neonatal Mortality Rates, Status Indians and Other Residents, B.C., 1997 to 2001**




Status Indians had higher stillbirth rates in all years, but none of the differences for any year or the five-year combined comparison were statistically significant (see figure 55).

**Figure 55. Stillbirth Rates, Status Indians and Other Residents, B.C., 1997 to 2001**

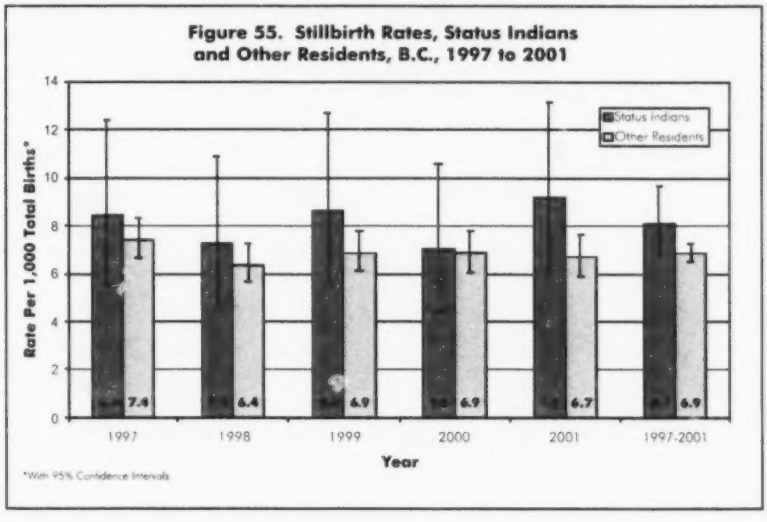
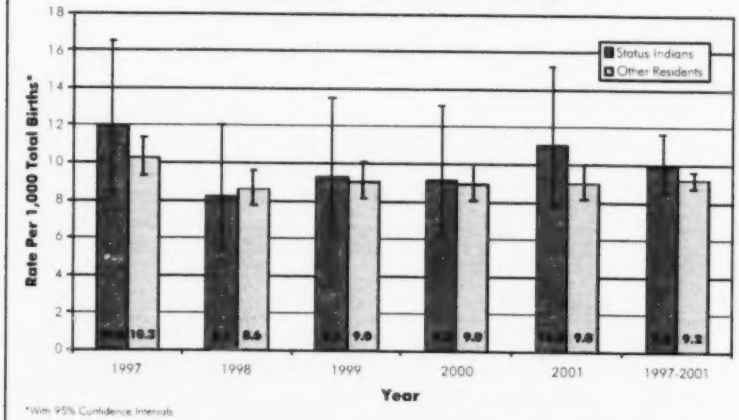
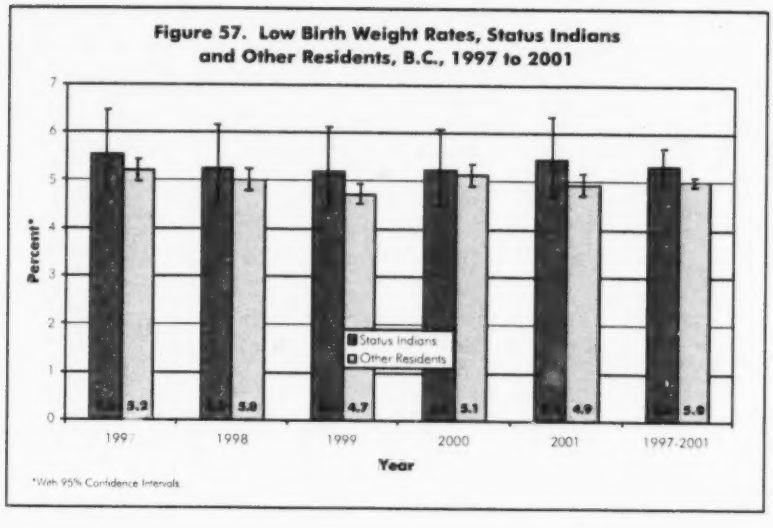


**Figure 56. Perinatal Mortality Rates, Status Indians and Other Residents, B.C., 1997 to 2001**




Perinatal mortality rates were also higher for Status Indians in most years and the five-year combined comparison. The differences were not statistically signficant (see figure 56).

**Figure 57. Low Birth Weight Rates, Status Indians and Other Residents, B.C., 1997 to 2001**

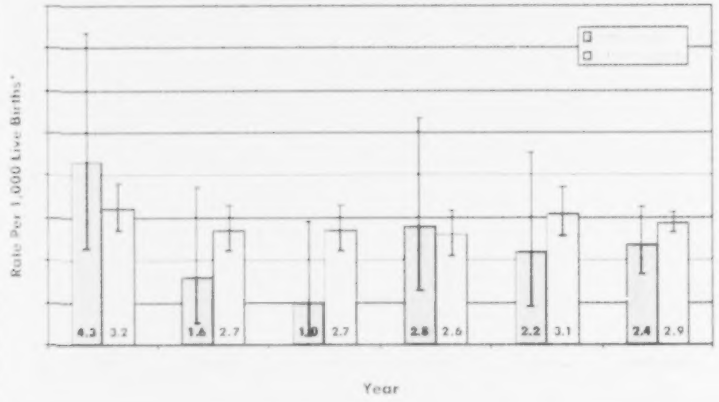



LBW rates were higher for Status Indians in all years and the five-year combined comparisons (see figure 57). The differences were not statistically significant.

In summary, for the combined five-year period 1997-2001, Status Indians had a statistically significant high post-neonatal mortality rate as compared to other B.C. residents. They also had higher overall infant mortality, stillbirth, and LBW rates, which were not statistically significant. Their lower neonatal mortality rate was not statistically significant.

Neonatal mortality showed more annual fluctuation (due to small numbers) for Status Indians, but was generally lower than for other B.C. residents (see figure 53). However, the differences were not statistically significant for any individual year or for the five-year combined comparison.

Figure 53. Neonatal Mortality Rates, Status Indians and Other Residents, B.C., 1997 to 2001

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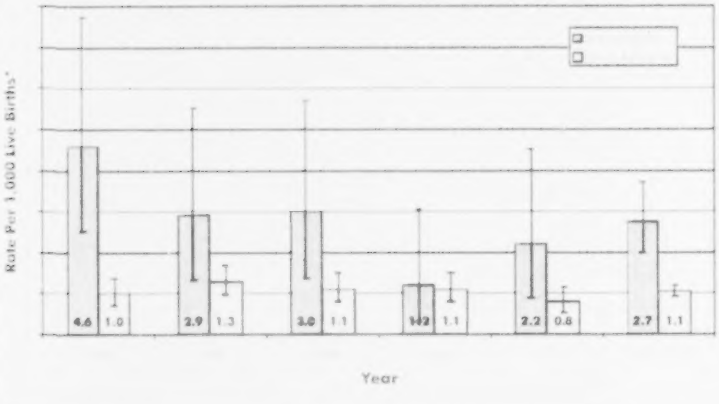


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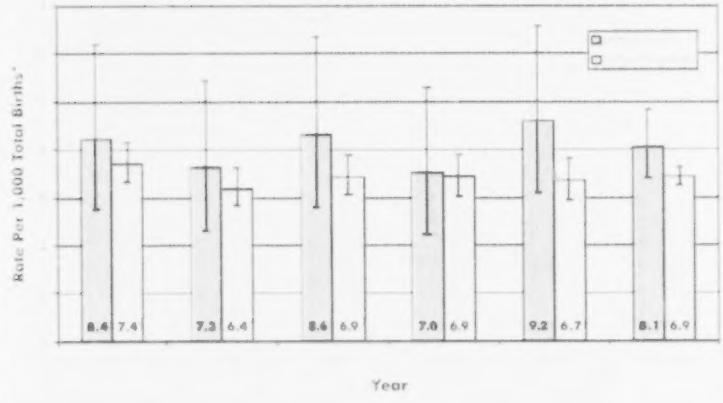
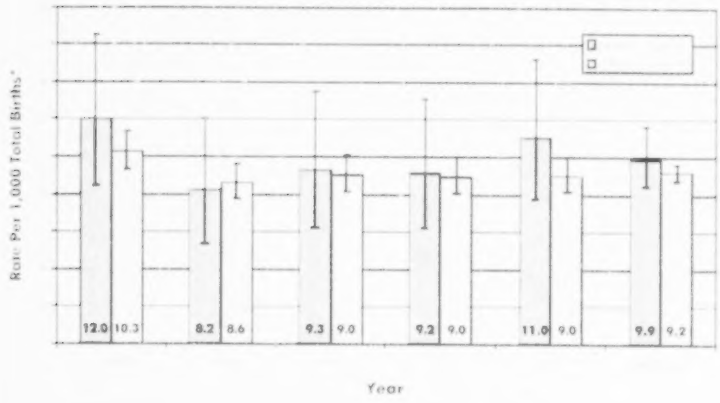


**Figure 56. Perinatal Mortality Rates, Status Indians and Other Residents, B.C., 1997 to 2001**

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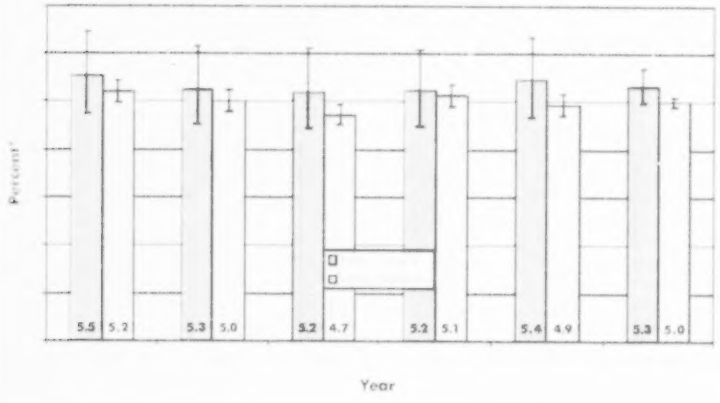



LBW rates were higher for Status Indians in all years and the five-year combined comparisons (see figure 57). The differences were not statistically significant.

In summary, for the combined five-year period 1997-2001, Status Indians had a statistically significant high post-neonatal mortality rate as compared to other B.C. residents. They also had higher overall infant mortality, stillbirth, and LBW rates, which were not statistically significant. Their lower neonatal mortality rate was not statistically significant.

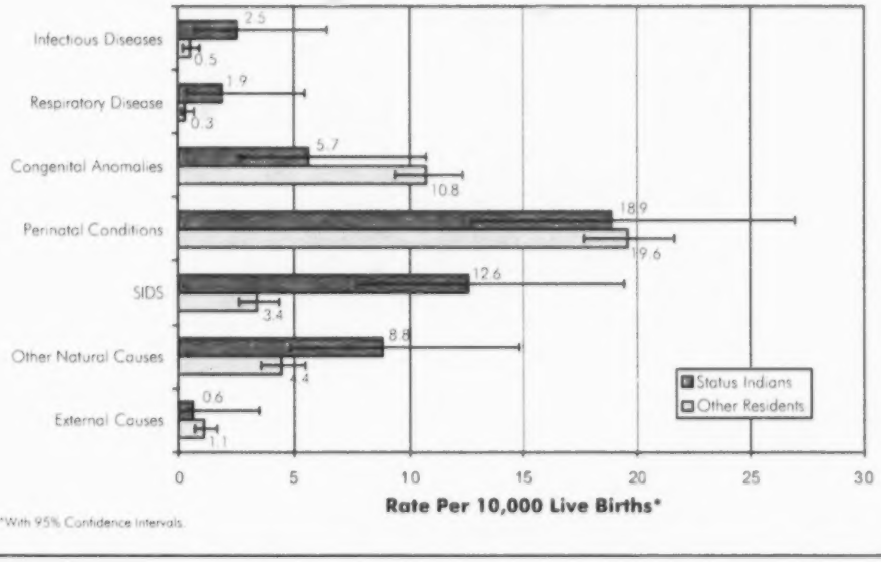
The post-neonatal mortality rate for Status Indians is of particular concern, as the significantly increased five-year combined rate was over twice that of other B.C. residents. While not statistically significant, their higher stillbirth rates and higher LBW rates are also of concern, due to the implications for fetal and infant health. Detailed data on these indicators are contained in table G.

**Table G: Infant Deaths, Stillbirths, Low Birth Weight Births, and Live Births, Status Indians and Other Residents, B.C., 1997-2001**

| Indicator | 1997 | | 1998 | | 1999 | | 2000 | | 2001 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Stat. Ind. | Others | Stat. Ind. | Others | Stat. Ind. | Others | Stat. Ind. | Others | Stat. Ind. | Others |
| Neonatal Deaths | 13 | 146 | 5 | 109 | 3 | 104 | 9 | 95 | 7 | 116 |
| Post-Neonatal Deaths | 14 | 56 | 9 | 51 | 9 | 42 | 4 | 41 | 7 | 29 |
| All Infant Deaths | 27 | 202 | 14 | 160 | 12 | 146 | 13 | 136 | 14 | 145 |
| Stillbirths | 26 | 335 | 23 | 278 | 26 | 294 | 23 | 281 | 30 | 283 |
| No. of Low Birth Weight Births | 169 | 2322 | 165 | 1987 | 155 | 1829 | 170 | 1909 | 176 | 1832 |
| No. of Live Births | 3057 | 44399 | 3139 | 39726 | 2985 | 38758 | 3251 | 37243 | 3230 | 37145 |

Status Indian infant deaths have been examined in detail by the B.C. Vital Statistics Agency.[17] The specific causes of infant deaths are shown in figure 58 for the period 1997 to 2001. The top three causes of Status Indian infant mortality were perinatal conditions, SIDS, and congenital anomalies. Status Indian infants had a significantly higher mortality due to SIDS and other natural causes. Mortality differences for other specific causes were not statistically significant.

**Figure 58. Infant Mortality Rates, Selected Causes of Death, Status Indians and Other Residents, B.C., 1997 to 2001**




The development of effective preventive strategies and programs in the Aboriginal population could help to reduce post-neonatal deaths due to SIDS, respiratory disease, and infections. This continuing gap in the infant health of First Nations people represents a disparity, the correction of which should be a high priority for all health and social service authorities.

17. B.C. Vital Statistics Agency, "Regional Analysis of Health Statistics for Status Indians in B.C., 1991-2001."

## Summary of Regional Sub-Analysis

Data by Health Authority were obtained to make the same 1999-2000 and 2001-2002 comparisons, and to assess trends over the 1987 to 2002 period. In summary, the results are:

Low Birth Weight Rate

- No differences between 1999-2000 and 2001-2002 were statistically significant in any Health Authority.
- No Health Authority had a rate in 2001-2002 that was significantly different from the provincial rate.
- Only the Fraser Health Authority had an increasing LBW trend over the period 1987-2002 (statistically significant). Most of the other Health Authorities had no significant change in rates over time, while the rate for the Northern Health Authority declined (statistically significant).

Infant and Fetal Mortality Indicators

- For infant mortality, neonatal mortality, stillbirth rates, and perinatal mortality, no Health Authority had differences in rates between 1999-2000 and 2001-2002 which were statistically significant. For post-neonatal mortality, only the Northern Health Authority had a difference in rates (lower in 2001-2002), which was statistically significant.
- For infant mortality, neonatal mortality, post-neonatal mortality, and perinatal mortality, no Health Authority had a rate in 2001-2002 which was significantly different than the provincial rate. For stillbirth rate, only the Northern Health Authority had a different rate (higher than the provincial rate) which was statistically significant.

## Factors Associated with Poor Pregnancy Outcomes

Poor pregnancy outcomes are associated with a number of factors. Whilst inadequate prenatal care or lack of access to prenatal care may be factors for many at-risk women, they are unlikely to play a major role in the cause of infant death, prematurity, or LBW in the general population of mothers. This is because family physician, specialist, or hospital services are substantially available throughout the province, notwithstanding some geographic challenges related to transportation distance and/or manpower availability in some communities. These challenges are unlikely to have contributed to the increase in the infant mortality rate in 2001-2002.

Other factors include maternal illnesses which may adversely affect the health of the mother or the fetus, and maternal behaviours such as tobacco smoking, alcohol and other drug use, and healthy nutrition/weight gain. Socio-environmental factors also play a role in mediating a woman's individual response to pregnancy, influencing the degree of support that she may obtain, and promoting or inhibiting her ability to make healthy choices.

In an unpublished analysis (in press) based on B.C. data, ZC Luo et al (2003) in cooperation with BCVSA, examined maternal and pregnancy characteristics by neighbourhood income quartile (NIQ) for the period 1985 to 2000. They found that living in a poorer neighbourhood in urban areas was associated with worse birth and infant health outcomes as determined by Adjusted Odds Ratios[18], i.e.

- Higher rates of preterm births
- Higher rates of stillbirths
- Higher rates of small for gestational age births
- Higher neonatal mortality rates
- Higher post-neonatal mortality rates[19]

The researchers found disparities in post-neonatal mortality due to causes of death which are substantially preventable, such as SIDS, infections, and injuries. This suggests that better infant care and improved environmental conditions for infants are needed in poorer neighbourhoods. In addition, poorer neighbourhoods in both urban and rural areas were associated with a higher prevalence of mothers being of Aboriginal ethnicity, being unmarried, and being adolescent.

These findings should not be a surprise, as low socio-economic status is clearly associated in the medical literature with poor health outcomes. Low Income Cut Off (LICO) rates for all women, including women under 18 years of age, have not significantly changed over the past 10 years. The LICO rate for females was 13.4 per cent in 1992, dropping slightly to 12.6 percent by 2001.[20] The unchanging LICO rate suggests that a significant increase in the number of at-risk women is unlikely to be a factor in the recent higher infant mortality rate, however, the unchanging LICO rates mirror the persisting LBW rates over the last ten years. The next section describes a program that is intended to improve birth outcomes for women in B.C.

## Interventions to Improve Pregnancy Outcomes

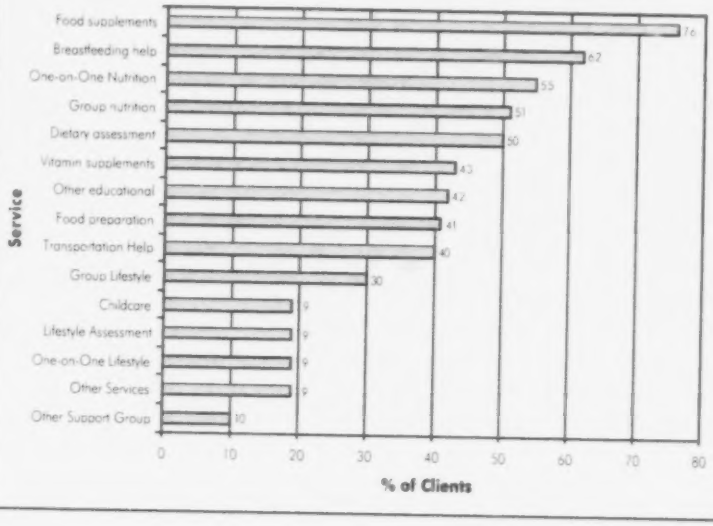
As described in the Pregnancy Outreach Program (POP) Provincial Annual Report 2001/02, the POP aims to improve healthy birth outcomes for pregnant women who experience risk conditions which threaten their health and their babies' development. Services are provided through 40 project sites[21] in 152 communities throughout the province. While the services among sites may vary somewhat, most POP sites include services such as food/vitamin supplements, nutrition counseling, breastfeeding support, dietary assessments, transportation services, food preparation training, lifestyle assessment, counseling, and support groups. Most sites indicated that the demand exceeded the services available. Across the province, a total of 5,216 clients received services in 2001/02, of whom 4,192 were prenatal. It is roughly estimated that POP clients may have contributed approximately 13 per cent of the 40,392 live births in the province during 2001.

18. Odds Ratios adjusted for parity, First Nations ethnicity, maternal age, marital status, and some other factors.
19. Based on Crude Relative Risk.
20. Statistics Canada. (2003, June). "Income in Canada, 2001", Ottawa, ON.
21. Of the 40 sites, 22 were provincially funded, and 18 were federally funded through the Canadian Prenatal Nutrition Program and the Community Action Program for Children.

Based on available data, various risk factors were over-represented among POP clients, including being single or in a common law relationship (65 per cent vs 25 per cent for all women giving birth), being Aboriginal (28 per cent vs 7 per cent of all women giving birth), having low income (49 per cent made less than $1,300 per month, and 32 per cent responded Don't Know/Refused), having low education (48 per cent had less than grade XII), being young (average age is 24 years, vs 29 years for all B.C. women giving birth), being a smoker (36 per cent vs 17 per cent for B.C. women), using alcohol (12 per cent), and using recreational drugs (10 per cent). The reported prevalence of these risk factors is a strong indication that POP services are reaching the women they were intended to assist. This premise is further supported by the fact that an estimated 25 per cent of POP clients were less than 20 years of age, which if extrapolated to provincial data, would mean that approximately 73 per cent of all teen mothers in the province in that year were POP clients.

During the period 2000 to 2002, POP clients had a LBW rate of 6.5 per cent, in comparison to the 5 per cent rate for the B.C. population. Extrapolating based on client numbers and 2001 provincial data, this would mean that POP clients experienced an estimated 23 per cent of all LBW singleton pregnancies in the province.[22] These data raise some interesting questions – (1) does this mean that POP services are not reaching the majority of pregnant women at risk of LBW (especially those over age 20 years), or (2) could we assume that POP services are effective in reducing the LBW rate to 6.5 per cent, lower than it otherwise would have been in the women who were clients? How do we know if POP services in B.C. are effective in improving healthy birth outcomes for women who experience an at-risk pregnancy?

**Figure 59: CPNP Services Received, Canada, 1996 to 2000**




An independent evaluation[23] of the Canada Prenatal Nutrition Program (CPNP) attempted to address these complex questions. The CPNP is a Health Canada initiative established in 1996, which funds almost half of the POP sites in B.C., and in many other locations across Canada. Nationally, detailed data were available for analysis on almost 30,000 clients. The national pooling of data from hundreds of projects and thousands of participants provided an opportunity for program evaluation that would not be possible in any individual project or province.[24]

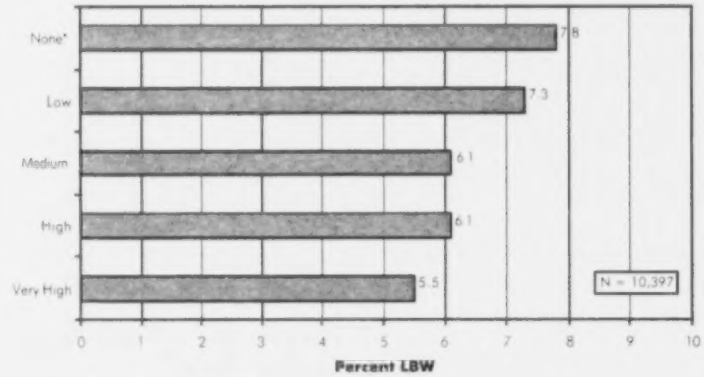
22. Multiple births were excluded from this estimate in order to improve comparability of POP client births with provincial births data.
23. Barrington Research Group, "Level of Service and Birth Weight in the Canada Prenatal Nutrition Program", Health Canada: May 2, 2002.
24. Even with the large numbers available for analysis in the CPNP, given the relatively small expected program effect, there was still an issue with small cell size for some aspects of the analysis. This meant that some findings, while suggestive of a positive effect, did not achieve statistical significance. However, as more data become available over time, this will be less of a problem, and statistical significance may be attained.

The range of services and proportion of clients receiving each service is shown in figure 59. A key aspect of the evaluation was the creation of an index developed from a weighted sum of 14 services (categorized as low, moderate, or high service levels), which was further adjusted by client duration in the program (expressed as early, moderate, or late entry into the program).

The resulting combined CPNP Service Index was categorized as low, moderate, high, very high, or none (a control group of post-natal clients who received no prenatal services). The results are summarized in figure 60, and were reported to be statistically significant ($p = 0.029$), showing a clear association between higher levels of service and lower LBW rates. Current data do not allow for a similar evaluation of POP services in B.C., however many B.C. clients are included in the national CPNP data.

Moreover, as POP services in B.C. (both CPNP and other services) are generally similar in nature and scope to the CPNP projects nationally, it is reasonable to presume that POP clients in B.C. are probably benefiting from a similar reduction in LBW rate.

**Figure 60. CPNP Service Index and Low Birth Weight Rate, Canada, 1996-2000**




* Control group consisted of post-natal clients who received no prenatal services.

Sources: CPNP, Health Canada, 2002.

Although not specifically addressed in the evaluation, such services may also provide other important benefits to the health of the mother and the infant, both prenatally and postnatally. However, as noted in the provincial POP Annual Report 2001/02, many POP programs have been unable to meet the demand for services, so it is also reasonable to presume that some women at risk of a LBW pregnancy are not receiving the POP services, that could be of benefit to them and their babies. This is an issue which warrants further consideration beyond the scope of this report.

## Summary of Findings

This review of infant mortality in B.C. has found that:

1. The infant mortality rate in B.C. has been declining for many years, but may now be approaching a point at which it may begin to level off. While our rates compare favourably with other jurisdictions in Canada and parts of Europe, they are not as low as Japan and some European countries.

2. While infant mortality has declined, the stillbirth rates in B.C. have remained unchanged over the last 16 years. This merits analysis beyond the scope of this review.

3. While the LBW rate in B.C. is comparable to other jurisdictions in Canada and parts of Europe, our rates are not as low as some European countries. While infant mortality has declined, the LBW rates in B.C. have remained unchanged at 5 per cent over the last 16 years, which merits analysis beyond the scope of this review.

4. The infant mortality rates for 2001 and 2002 were higher than the rates in 1999 and 2000, but the difference did not achieve statistical significance, and on the balance of evidence is believed to be a chance variation in the long term declining trend.

5. The excess in infant mortality of 31 additional deaths in 2001 and 2002 can be attributed in large part to an additional 27 deaths amongst infants of <1,500 grams and <28 weeks gestation - a group of infants with a particularly high mortality risk. As the mortality rate of other infants decreases over time, the mortality experience of this group is contributing proportionally more to the overall infant mortality rate.

6. The data clearly show that LBW infants have an increased risk of mortality, with the highest mortality occurring in the lowest weight infants. The pattern is similar for gestational age.

7. The proportion of pre-term (<37 weeks) births has increased significantly from 6.1 per cent in 1987 to 7.1 per cent in 2002.

8. Multiple births have increased significantly from 2.1 per cent in 1987 to 3.0 per cent in 2002, with the increase predominantly occurring in mothers aged 35+ years. The LBW rate for multiple births is close to 50 per cent. The potential role of infertility treatment and the associated risks merit further analysis that is beyond the scope of this review.

9. Status Indian infants have an increased rate of post-neonatal mortality (statistically significant), and increased rates of LBW and stillbirths (neither are statistically significant).

10. An unpublished B.C. study found that poverty was associated with poor pregnancy outcomes, and that poorer neighbourhoods had a disproportionately high number of Aboriginal people.

11. Services such as the Pregnancy Outreach Program (POP) have been established to support at-risk pregnant women in B.C. and other provinces. Evaluation at the national level has found such services to be effective in increasing the birth weights of babies born to at-risk mothers.

12. Statistics in the annual report of POP in B.C. indicate that while an estimated 23 per cent of all mothers of LBW infants receive POP services, many POP sites report that they are unable to meet the demand for their services.

## Prevention of Fetal-Infant Mortality

A framework for the estimation of preventable fetal-infant mortality has been developed by Centres for Disease Control and Prevention (CDCP) Atlanta and adapted by the Canadian Perinatal Surveillance System (see table H). The model categorizes stillbirths and infant deaths by birth weight and age at death, and indicates the most relevant determinant of the adverse outcome (maternal health, maternal care, newborn care, and infant environment). Applying the model involves the selection of a benchmark, then comparing regional or sub-population outcomes to that benchmark, in order to determine the disparity, and hence the potential degree of preventability.

**Table H: Framework for Estimation of Preventable Fetal-Infant Mortality, Canadian Perinatal Surveillance System***

| Birth Weight (in grams) | Late Fetal (28+ weeks) | Early Neonatal (< 7 days) | Late Neonatal (7-27 days) | Post-Neonatal (28 - 364 days) |
|---|---|---|---|---|
| < 1500 | Maternal Health | | | |
| 1500-2499 | Maternal Care | Newborn Care | | |
| 2500+ | | | Infant Environment | |

* Source: B. McCarthy, CDCP Atlanta, as described in "Perinatal Health Indicators for Canada", Canadian Perinatal Surveillance System, Health Canada, 2000: 57-59.

Although this report specifically focused on infant mortality, the problem of infant deaths cannot be viewed in isolation of the social context of maternal and child health, such as:

- Why are women living in at-risk conditions, and what could be done to improve their situation?
- Why are at-risk women becoming pregnant, and if not wanting to become pregnant, do they have access to appropriate contraceptive measures or abortion services?
- What happens to at-risk pregnant women and their infants who do not receive sufficient medical and/or Pregnancy Outreach Program services?
- What happens to at-risk women and their infants, who continue to live in difficult circumstances, and what happens to that infant later in childhood?
- Why are Aboriginal women and infants disproportionately represented in at-risk circumstances?

## Recommendations

Based on the information reviewed for this report, it is recommended that:

1. B.C. should establish a goal of attaining the lowest achievable infant mortality rates.

2. As a long-term tool to develop effective maternal and child health services, the Canadian Perinatal Surveillance System framework for preventable fetal-infant mortality should be assessed by Health Authorities, B.C. Children's and B.C. Women's Hospitals, the B.C. Reproductive Care Program, Aboriginal representatives, concerned professional groups, and appropriate other interested parties. The framework should be adapted for application in B.C., with a view to determining specific strategies for future improvement in our rates of low birth weight, stillbirths, and infant deaths. Issues include the selection of appropriate benchmarks, reproductive trends, the diversity of our population, and disparities based on social, ethnic, or regional factors.

3. The Ministries of Health, the Health Authorities, B.C. Children's and B.C. Women's Hospitals, the B.C. Reproductive Care Program, Aboriginal representatives, concerned professional groups, and appropriate other interested parties should collaborate in the monitoring of infant health outcomes and the evaluation of maternal and child health services in order to attain the best possible health outcomes for babies and mothers in B.C. Particular attention should be placed on disparities.

4. In the short-term, pending the availability and application of the results of that assessment, the role of Pregnancy Outreach Program (POP) services in B.C. should be reviewed, in order to determine how more women with at-risk pregnancies can benefit from these services. The value of these services is supported by a growing evidence base, suggesting that POP services can be regarded as an important complement to the core function of maternal and child health services as provided by community health nurses, physicians, and midwives.

5. In view of the disparities noted in this report, a major emphasis should be placed on improving maternal and infant health in Aboriginal communities.

6. The provincial and federal governments should give consideration to ways in which the income status of pregnant women can be improved (e.g., create a maternal nutrition benefit to start once pregnancy is confirmed, that becomes the Child Benefit once the birth is registered). Such a benefit would be cost-neutral if the Child Benefit program was terminated 6 months earlier than at present.

# Appendix A – Acknowledgements

The Provincial Health Officer, Dr. Perry Kendall is grateful to the staff of the **B.C. Vital Statistics Agency**, and to the many other individuals who assisted in the preparation of this report, through their advice, the review of drafts, or technical support.

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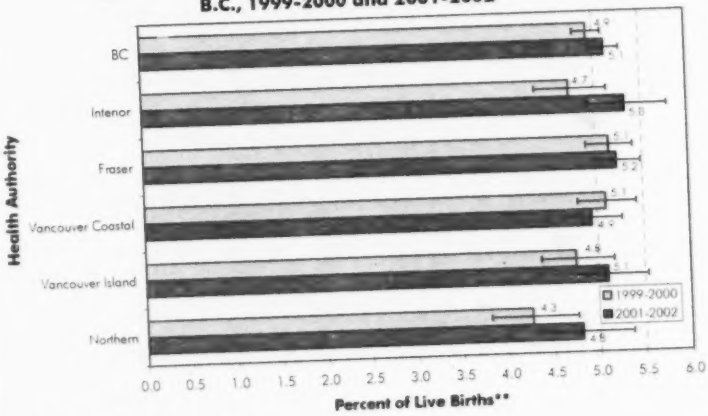
# Appendix B – Infant and Perinatal Indicators by Health Authority

## Low Birth Weight

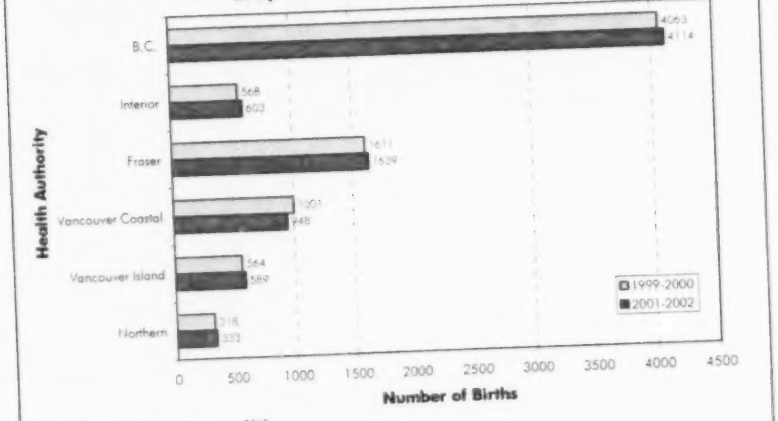
LBW rates were assessed, and were higher in the latter period for the province and most Health Authorities. None of the differences were statistically significant, and no Health Authority differed significantly from the provincial average (see figures B.1. and B.2.)

**Figure B.1. Low Birth Weight* Rates by Health Authority, B.C., 1999-2000 and 2001-2002**




* Live Birth newborn with weight less than 2500 grams
** With 95% Confidence Intervals

**Figure B.2. Low Birth Weight* Births by Health Authority, B.C., 1999-2000 and 2001-2002**




* Live Birth newborn with weight less than 2500 grams

Since 1987, there was no significant change in LBW rate for B.C. or the Interior, Vancouver Coastal, or Vancouver Island Health Authorities. There was a statistically significant increasing trend in Fraser Health Authority and a significant decreasing trend in Northern Health Authority (see figures B.3. to B.7.).

**Figure B.3. Low Birth Weight Rates, Interior Health Authority, B.C., 1987 to 2002**

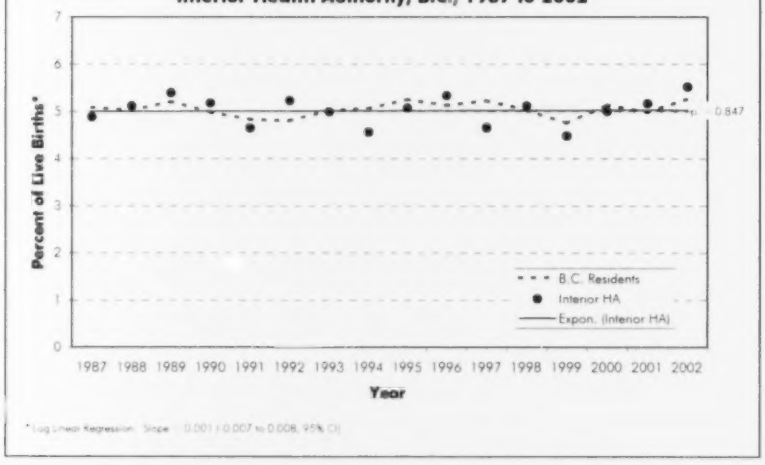



**Figure B.4. Low Birth Weight Rates, Fraser Health Authority, B.C., 1987 to 2002**

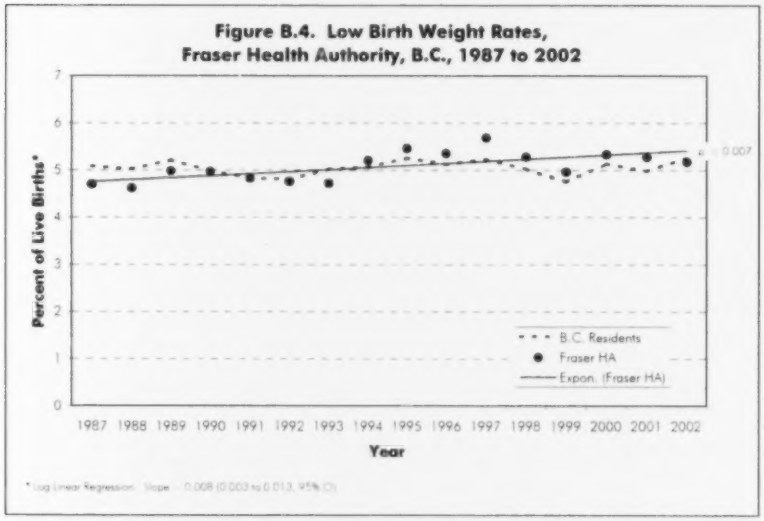
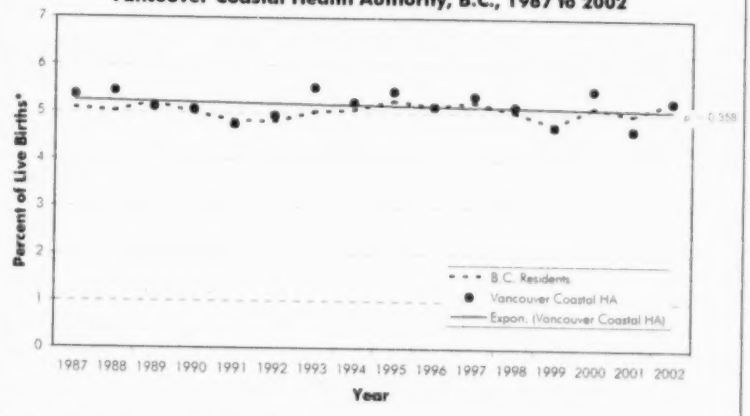
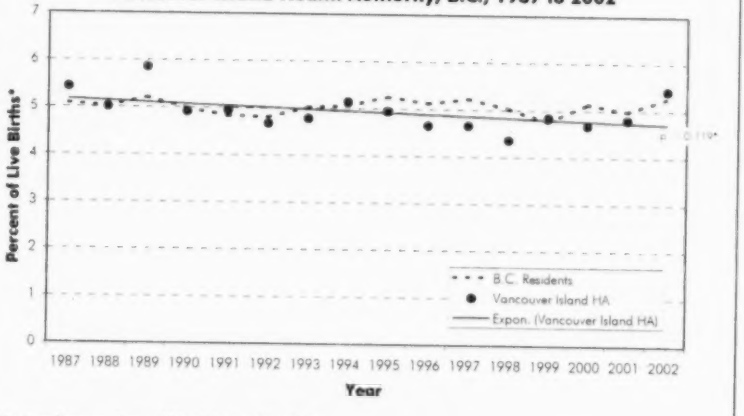


**Figure B.5. Low Birth Weight Rates, Vancouver Coastal Health Authority, B.C., 1987 to 2002**



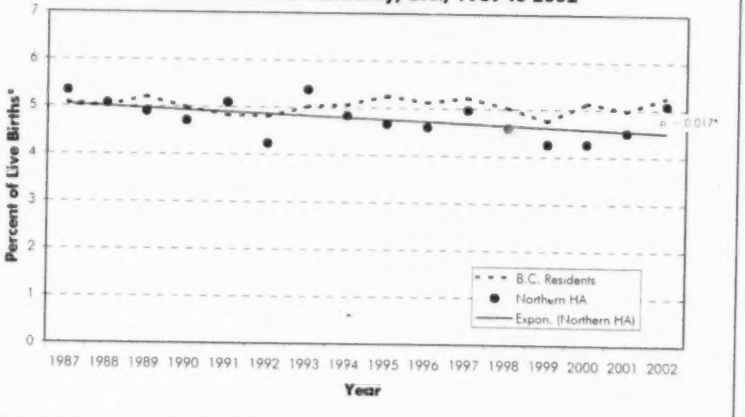

* Log Linear Regression: Slope = -0.003 (-0.009 to 0.004, 95% CI)

**Figure B.6. Low Birth Weight Rates, Vancouver Island Health Authority, B.C., 1987 to 2002**




* Log Linear Regression: Slope = -0.006 (-0.014 to 0.002, 95% CI)

**Figure B.7. Low Birth Weight Rates, Northern Health Authority, B.C., 1987 to 2002**




* Log Linear Regression: Slope = -0.009 (-0.015 to -0.002, 95% CI)

## Infant Mortality

While the overall provincial infant mortality rate did not show a statistically significant increase between 1999-2000 and 2001-2002, Health Authorities data were also assessed for the same two-year comparisons. For overall infant mortality (see figures B.8. and B.9.), the results showed that three Health Authorities had increases and two Health Authorities had a slight decrease. However, none of the differences between time periods were statistically significant for any Health Authority, nor did the rates for any Health Authority differ significantly from the provincial average.

**Figure B.8. Infant Mortality Rates, B.C., 1999-2000 and 2001-2002**

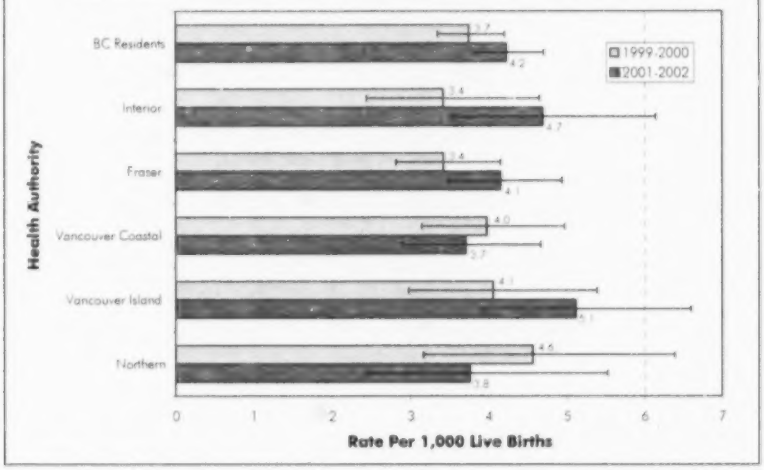
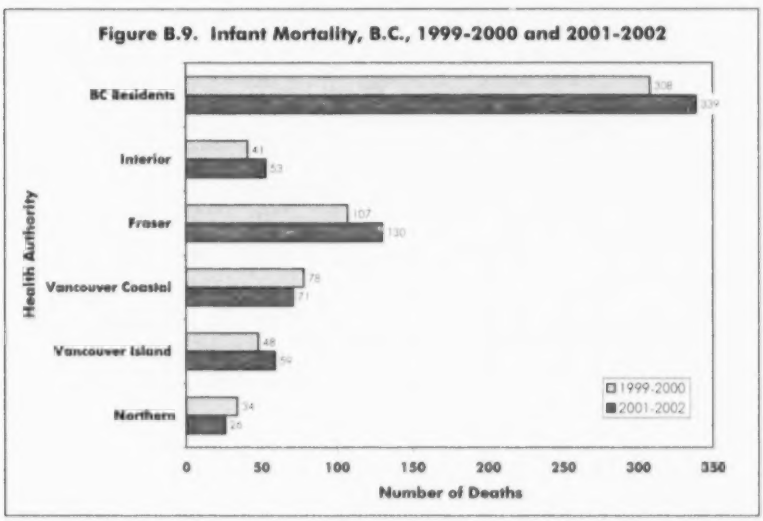
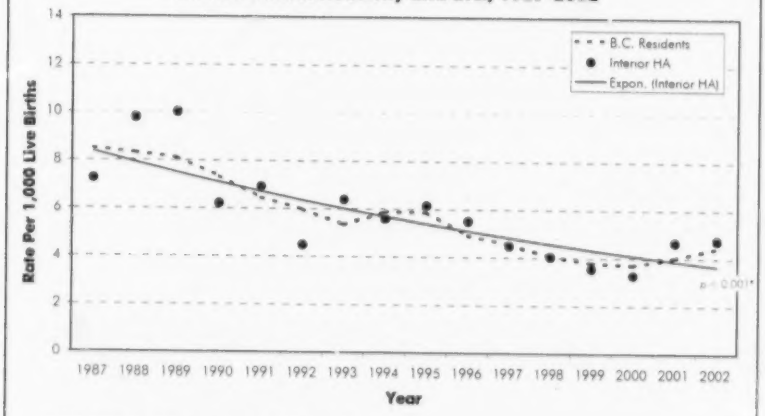



**Figure B.9. Infant Mortality, B.C., 1999-2000 and 2001-2002**



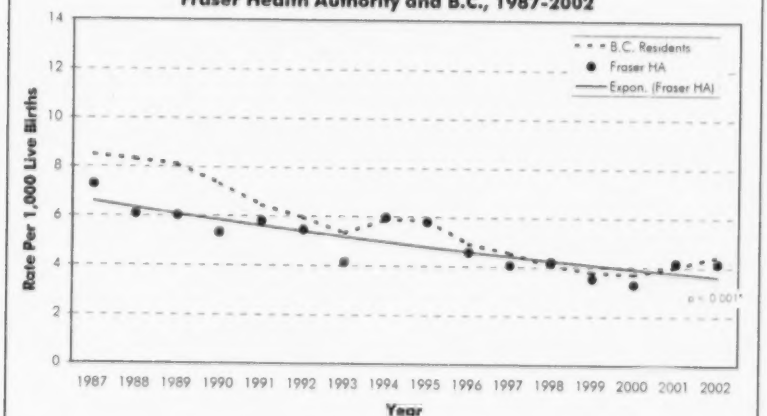
On assessing the infant mortality trend by Health Authority from 1987 to 2002, all experienced a significant decline (see Figures B.10. to B.14).

**Figure B.10. Infant Mortality Rates, Interior Health Authority and B.C., 1987-2002**




* Log Linear Regression: Slope = -0.055 (-0.078 to -0.033, 95% CI)

**Figure B.11. Infant Mortality Rates, Fraser Health Authority and B.C., 1987-2002**




* Log Linear Regression: Slope = -0.040 (-0.055 to -0.025, 95% CI)

**Figure B.12. Infant Mortality Rates, Vancouver Coastal Health Authority and B.C., 1987-2002**

**Figure B.13. Infant Deaths Per 1,000 Live Births, Vancouver Island Health Authority and B.C., 1987-2002**

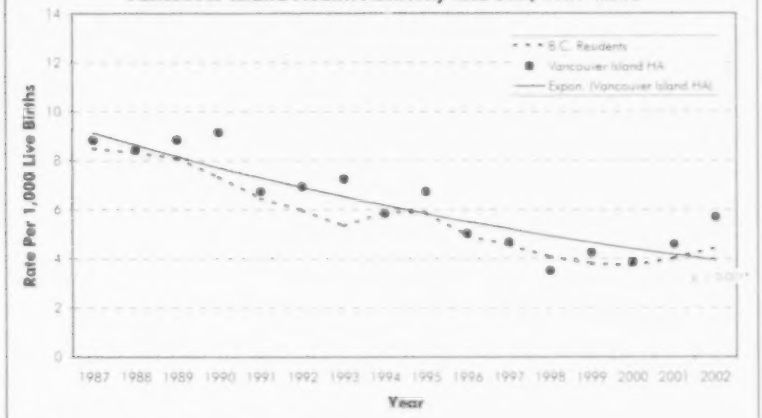
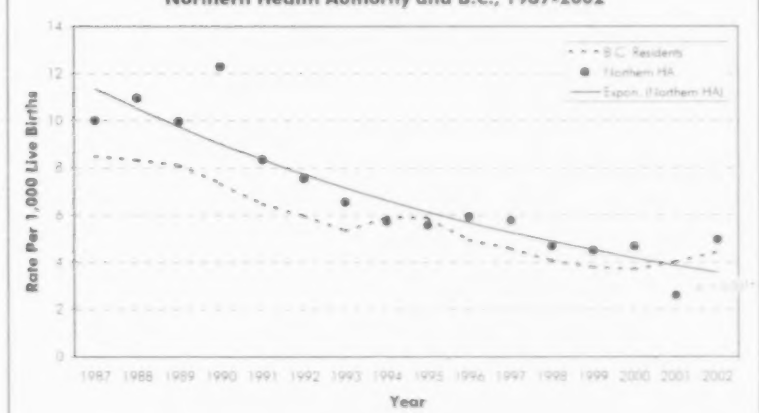



**Figure B.14. Infant Deaths Per 1,000 Live Births, Northern Health Authority and B.C., 1987-2002**



## Neonatal Mortality

For neonatal mortality (See Figures B.15. and B.16.), the province and most Health Authorities had an increase in the latter period, which was not statistically significant. Nor did any Health Authority differ significantly from the provincial average.

**Figure B.15. Neonatal (<28 days) Mortality Rates, B.C., 1999-2000 and 2001-2002**

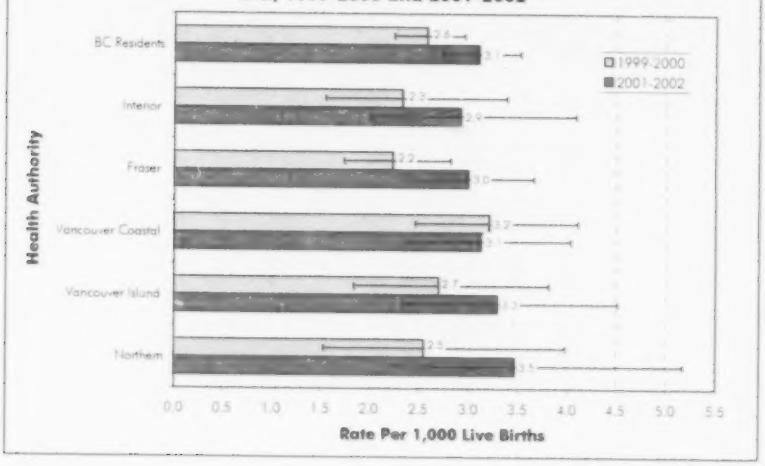
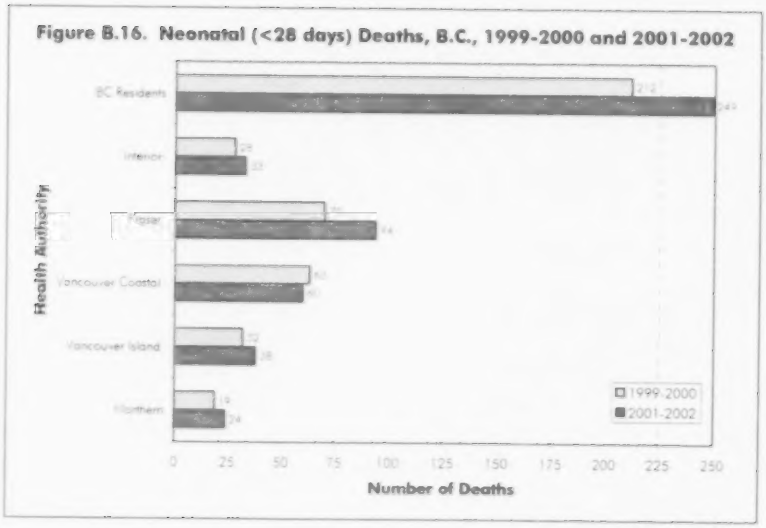



**Figure B.16. Neonatal (<28 days) Deaths, B.C., 1999-2000 and 2001-2002**



## Post-Neonatal Mortality

For post-neonatal mortality (see Figures B.17. and B.18.), the decrease in the provincial rate was not statistically significant. There were variable results by Health Authority, but the only statistically significant difference was the decrease in the Northern Health Authority in the latter period.* No Health Authority differed significantly from the provincial average.

**Figure B.17. Post-Neonatal (28-364 days) Mortality Rates, B.C., 1999-2000 and 2001-2002**

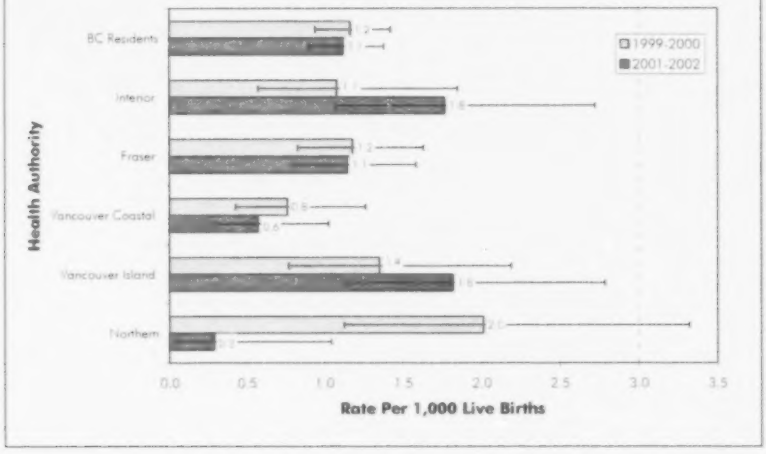
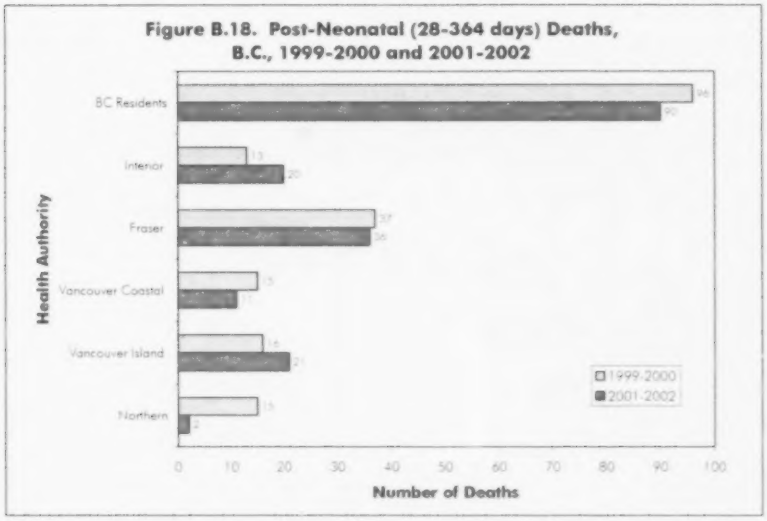



**Figure B.18. Post-Neonatal (28-364 days) Deaths, B.C., 1999-2000 and 2001-2002**




* Caution regarding small numbers, as the rate in 2001-2002 was based on less than 5 deaths.

## Stillbirth Rate

For stillbirth rates, (see Figures B.19. and B.20.) the increase in the provincial rate was not statistically significant. The Northern Health Authority rate was significantly higher than the provincial rate in 2001-2002, and no Health Authority had statistically significant differences in rates between the comparison periods.

**Figure B.19. Stillbirth Rates, B.C., 1999-2000 and 2001-2002**

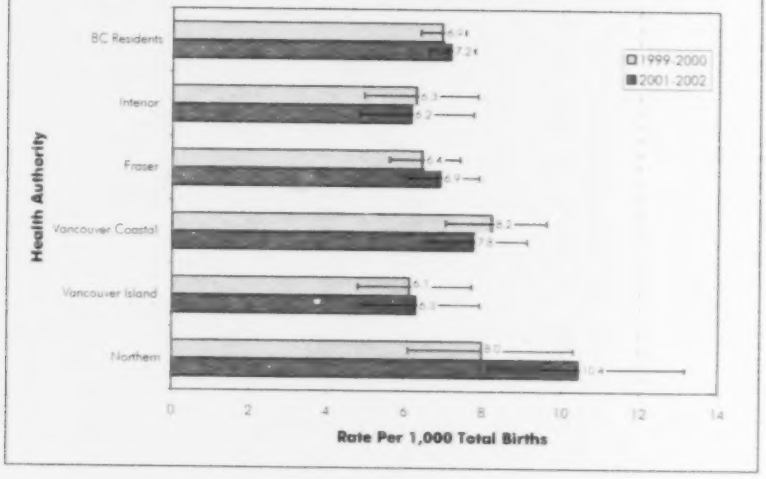
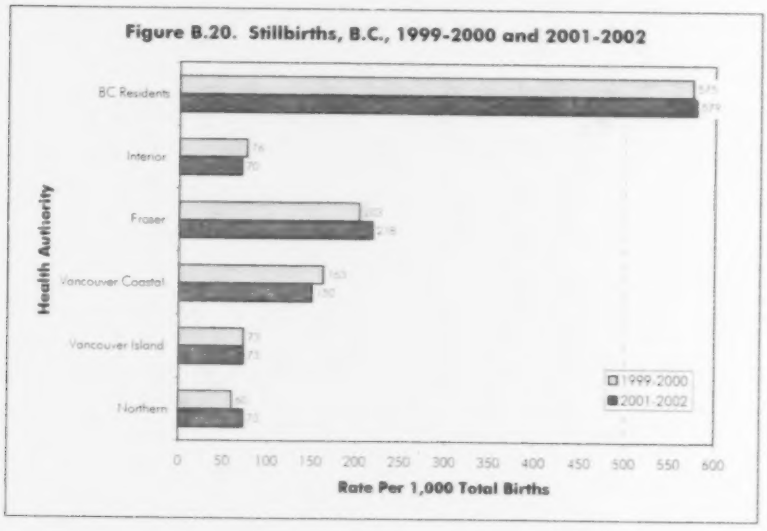



**Figure B.20. Stillbirths, B.C., 1999-2000 and 2001-2002**



## Perinatal Mortality

For perinatal mortality (see Figures B.21. and B.22.), most Health Authorities and the province had higher rates in the later period, however, none of the differences between time periods were statistically significant, and no Health Authority differed significantly from the provincial average.

**Figure B.21. Perinatal Mortality Rates, B.C., 1999-2000 and 2001-2002**

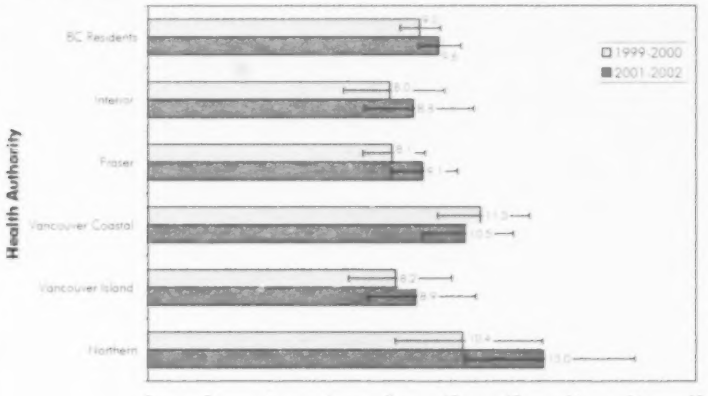
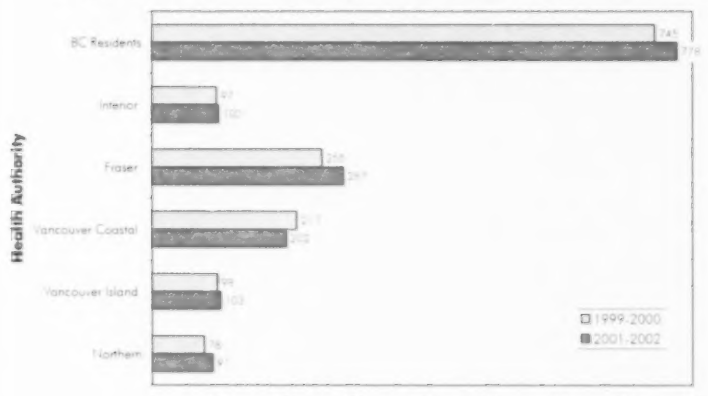



**Figure B.22. Perinatal Mortality, B.C., 1999-2000 and 2001-2002**



## Appendix C - Causes of Death: Stillbirths and Perinatal Mortality

The diagnoses associated with infant deaths and stillbirths for the years 1999 to 2002 were obtained from the B.C. Vital Statistics Agency. Table C-1 contains the diagnoses for the 1,154 stillbirths over the last 4 years, while Table C-2 has the rates (with 95 confidence intervals) for those diagnoses where the difference in number of stillbirths between the two-year comparison periods was 5 or more. Congenital anomalies deaths (particularly other and multiple system syndromes) was significantly higher in the earlier period, and deaths due to other disorders originating in the perinatal period was significantly higher in the latter period. However, all deaths due to perinatal conditions did not differ significantly between the periods.

### Table C-1: Selected Causes of Stillbirths B.C. Residents, 1999-2000 and 2001-2002

| Cause of Death | ICD-10 Code(s) | Stillbirths | | Excess Stillbirths in 2001-2002 |
|---|---|---|---|---|
| | | 1999-2000 | 2000-2001 | |
| Perinatal conditions | | | | |
| Infant affected by maternal factors | P00-P04 | 224 | 225 | 1 |
| Premature/postmature and fetal growth disorders | P05-P08 | 25 | 11 | -14 |
| Birth trauma | P10-P15 | 1 | 1 | 0 |
| Respiratory and cardiovascular disorders | P20-P29 | 23 | 17 | -6 |
| Infections specific to the perinatal period | P35-P39 | 3 | 1 | -2 |
| Hemorrhage and hematological disorders | P50-P61 | 4 | 3 | -1 |
| Transitory endocrine and metabolic disorders | P70-P74 | 1 | 0 | -1 |
| Digestive system disorders of fetus and newborn | P75-P78 | 0 | 0 | 0 |
| Other disorders originating in the perinatal period | P80-P94, P96 | 111 | 186 | 75 |
| Fetal death of unknown cause | P95 | 87 | 93 | 6 |
| Total deaths due to perinatal conditions | P00-P96 | 479 | 537 | 58 |
| Congenital anomalies | | | | |
| - of the nervous system | Q00-Q07 | 16 | 4 | -12 |
| - of the eye, ear, face & neck | Q10-Q18 | 0 | 0 | 0 |
| - of the heart and circulatory system | Q20-Q28 | 7 | 10 | 3 |
| - of the respiratory system | Q30-Q34 | 1 | 0 | -1 |
| - of the digestive system | Q35-Q45 | 1 | 0 | -1 |
| - of the genital organs | Q50-Q56 | 0 | 0 | 0 |
| - of the urinary system | Q60-Q64 | 3 | 2 | -1 |
| - of the musculoskeletal system | Q65-Q79 | 6 | 4 | -2 |
| Other and multiple system syndromes | Q80-Q89 | 22 | 2 | -20 |
| Chromosomal anomalies | Q90-Q99 | 34 | 20 | -14 |
| Total deaths due to congenital anomalies | Q00-Q99 | 90 | 42 | -48 |
| Pneumonia/influenza | J10-J18.1, J18.8-J18.9 | 0 | 0 | 0 |
| Sudden infant death syndrome (SIDS) | R95 | 0 | 0 | 0 |
| Other causes* | | 6 | 0 | -6 |
| TOTAL | | 575 | 579 | 4 |

* Some infant deaths that were still under investigation (ICD-10 code R99) may later be identified as SIDS.

### Table C-2: Selected Causes of Stillbirths B.C. Residents, 1999-2000 and 2001-2002

| Cause of Death | 1999-2000 | | | 2001-2002 | | | Statistically Significant Difference* |
|---|---|---|---|---|---|---|---|
| | Stillbirths | Rate Per 10,000 Total Births | 95% C.I. | Stillbirths | Rate Per 10,000 Total Births | 95% C.I. | |
| **Perinatal conditions** | | | | | | | |
| Premature/postmature and fetal growth disorders | 25 | 3.02 | 1.95 to 4.47 | 11 | 1.36 | 0.68 to 2.44 | |
| Respiratory and cardiovascular disorders | 23 | 2.78 | 1.76 to 4.17 | 17 | 2.10 | 1.22 to 3.36 | |
| **Other disorders originating in the perinatal period** | 111 | 13.40 | 11.08 to 16.21 | **186** | **23.01** | **19.87 to 26.63** | * |
| Fetal death of unknown cause | 87 | 10.51 | 8.41 to 12.92 | 93 | 11.50 | 9.28 to 14.15 | |
| **Total deaths due to perinatal conditions** | 479 | 57.84 | 52.83 to 63.17 | 537 | 66.43 | 60.98 to 72.19 | |
| **Congenital anomalies** | | | | | | | |
| - of the nervous system | 16 | 1.93 | 1.11 to 3.13 | 4 | 0.49 | 0.14 to 1.27 | |
| **Other and multiple system syndromes** | **22** | **2.66** | **1.67 to 4.01** | 2 | 0.25 | 0.03 to 0.89 | * |
| Chromosomal anomalies | 34 | 4.11 | 2.85 to 5.75 | 20 | 2.47 | 1.51 to 3.81 | |
| **Total deaths due to congenital anomalies** | **90** | **10.87** | **8.74 to 13.37** | 42 | 5.20 | 3.73 to 7.01 | * |
| Other causes* * | 6 | 0.72 | 0.27 to 1.58 | 0 | 0.00 | | |
| **TOTAL** | 575 | 69.43 | 63.93 to 75.41 | 579 | 71.62 | 65.98 to 77.56 | |

* Statistically significant at p < 0.05

** Some infant deaths that were still under investigation (ICD-10 code R99) may later be identified as SIDS.

Table C-3 contains the diagnoses for the 1,523 perinatal deaths over the last 4 years, while Table C-4 has the rate (with 95 per cent confidence intervals) for those diagnoses where the difference in number of deaths in between the two time periods was 5 or more. Deaths due to other disorders originating in the perinatal period were significantly higher in the latter period, but the difference between the periods for all deaths due to perinatal conditions was not statistically significant.

**Table C-3, Selected Causes of Perinatal Deaths**
**B.C. Residents, 1999-2000 and 2001-2002**

| Cause of Death | ICD-10 Code(s) | Perinatal Deaths | | Excess Perinatal Deaths in 2001-2002 |
|---|---|---|---|---|
| | | 1999-2000 | 2000-2001 | |
| Perinatal conditions | | | | 0 |
| Infant affected by maternal factors | P00-P04 | 278 | 287 | 9 |
| Premature/postmature and fetal growth disorders | P05-P08 | 40 | 40 | 0 |
| Birth trauma | P10-P15 | 5 | 1 | -4 |
| Respiratory and cardiovascular disorders | P20-P29 | 63 | 43 | -20 |
| Infections specific to the perinatal period | P35-P39 | 6 | 6 | 0 |
| Hemorrhage and hematological disorders | P50-P61 | 11 | 13 | 2 |
| Transitory endocrine and metabolic disorders | P70-P74 | 1 | 0 | -1 |
| Digestive system disorders of fetus and newborn | P75-P78 | 0 | 1 | 1 |
| Other disorders originating in the perinatal period | P80-P94, P96 | 120 | 200 | 80 |
| Fetal death of unknown cause | P95 | 87 | 93 | 6 |
| Total deaths due to perinatal conditions | P00-P96 | 611 | 684 | 73 |
| Congenital anomalies | | | | |
| - of the nervous system | Q00-Q07 | 22 | 15 | -7 |
| - of the eye, ear, face & neck | Q10-Q18 | 0 | 0 | 0 |
| - of the heart and circulatory system | Q20-Q28 | 14 | 19 | 5 |
| - of the respiratory system | Q30-Q34 | 9 | 4 | -5 |
| - of the digestive system | Q35-Q45 | 1 | 0 | -1 |
| - of the genital organs | Q50-Q56 | 0 | 0 | 0 |
| - of the urinary system | Q60-Q64 | 4 | 4 | 0 |
| - of the musculoskeletal system | Q65-Q79 | 8 | 11 | 3 |
| Other and multiple system syndromes | Q80-Q89 | 25 | 8 | -17 |
| Chromosomal anomalies | Q90-Q99 | 38 | 32 | -6 |
| Total deaths due to congenital anomalies | Q00-Q99 | 121 | 93 | -28 |
| Pneumonia/influenza | J10-J18.1, J18.8-J18.9 | 0 | 0 | 0 |
| Sudden infant death syndrome (SIDS) | R95 | 0 | 0 | 0 |
| Other causes* | | 13 | 1 | -12 |
| TOTAL | | 745 | 778 | 33 |

* Some infant deaths that wre still under investigation (R99) may later be identifeid as SIDS.

**Table C-4, Selected Causes of Perinatal Deaths**
**B.C. Residents, 1999-2000 and 2001-2002**

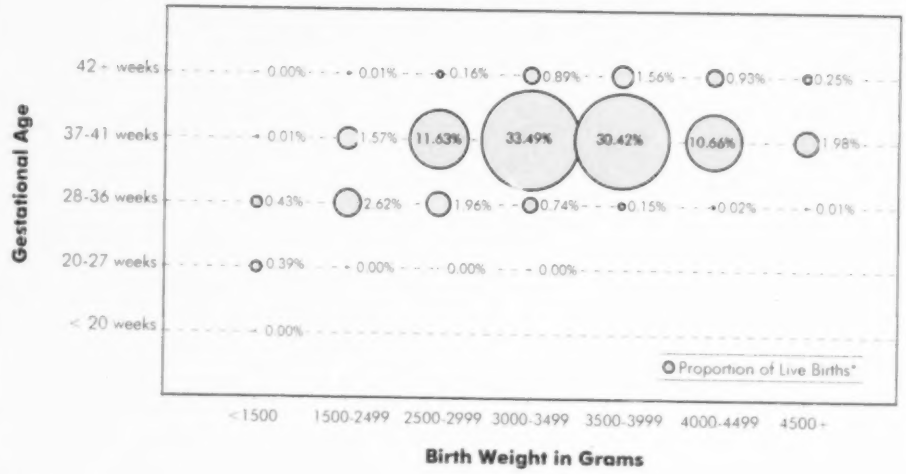
| Cause of Death | 1999-2000 | | | 2001-2002 | | | Statistically Significant Difference* |
|---|---|---|---|---|---|---|---|
| | Perinatal Deaths | Rate Per 10,000 Total Births | 95% C.I. | Perinatal Deaths | Rate Per 10,000 Total Births | 95% C.I. | |
| **Perinatal conditions** | | | | | | | |
| Infant affected by maternal factors | 278 | 33.57 | 29.79 to 37.82 | 287 | 35.50 | 31.57 to 39.92 | |
| Respiratory and cardiovascular disorders | 63 | 7.61 | 5.84 to 9.74 | 43 | 5.32 | 3.84 to 7.18 | |
| **Other disorders originating in the perinatal period** | 120 | 14.49 | 12.06 to 17.39 | **200** | **24.74** | **21.48 to 28.48** | * |
| Fetal death of unknown cause | 87 | 10.51 | 8.41 to 12.92 | 93 | 11.50 | 9.28 to 14.15 | |
| Total deaths due to perinatal conditions | 611 | 73.78 | 68.10 to 79.93 | 684 | 84.61 | 78.44 to 91.26 | |
| **Congenital anomalies** | | | | | | | |
| - of the nervous system | 22 | 2.66 | 1.67 to 4.01 | 15 | 1.86 | 1.04 to 3.06 | |
| - of the heart and circulatory system | 14 | 1.69 | 0.92 to 2.84 | 19 | 2.35 | 1.41 to 3.67 | |
| - of the respiratory system | 9 | 1.09 | 0.50 to 2.06 | 4 | 0.49 | 0.14 to 1.27 | |
| Other and multiple system syndromes | 25 | 3.02 | 1.95 to 4.47 | 8 | 0.99 | 0.43 to 1.95 | |
| Chromosomal anomalies | 38 | 4.59 | 3.25 to 6.29 | 32 | 3.96 | 2.71 to 5.58 | |
| Total deaths due to congenital anomalies | 121 | 14.61 | 12.17 to 17.52 | 93 | 11.50 | 9.28 to 14.15 | |
| **Other causes**** | **13** | **1.57** | **0.84 to 2.68** | 1 | 0.12 | 0.00 to 0.69 | * |
| TOTAL | 745 | 89.96 | 83.61 to 96.72 | 778 | 96.24 | 89.65 to 103.31 | |

* Statistically significant at p<0.05

** Some infant deaths that were still under investigation (ICD-10 code R99) may later be identified as SIDS

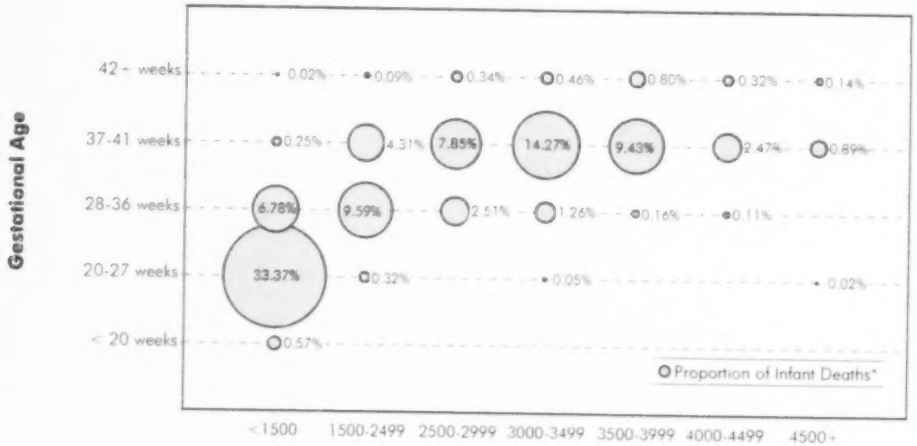
# Appendix D - Births and Infant Mortality by Birth Weight and Gestational Age

**Figure D.2. Proportion of Live Births* by Birth Weight and Gestational Age, B.C., 2198 to 2007**



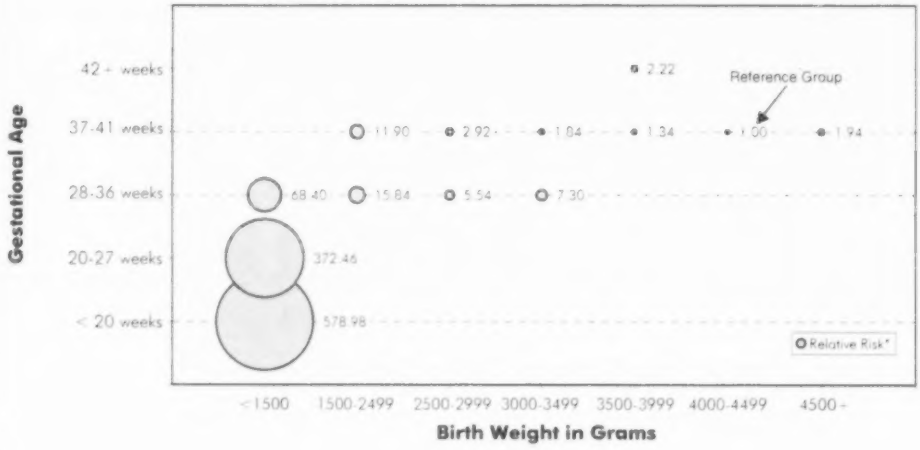

* Births of unknown gestational age or unknown birth weight are not included. Only 973 of the total 750,833 births are not represented on this graph.

**Figure D.2. Proportion of Infant Mortality By Birth Weight and Gestational Age, B.C., 1987 to 2002**




* Infant deaths of unknown gestational age or unknown birth weight are not included. Only 159 of the total 4,381 infant deaths are not represented on this graph.

**Figure D.3. Relative Risk of Infant Mortality By Birth Weight and Gestational Age, B.C., 1987 to 2002**




* Relative Risk is the ratio of the infant mortality rate for a given gestational age/birth weight combination to the infant mortality rate for births of 37-41 weeks gestational age and 4000-4499 grams birth weight. Combinations of gestational age/birth weight with fewer than 25 deaths over the period 1987-2002 are not included. Infant deaths of unknown gestational age or unknown birth weight are not included. Only 198 infant deaths of the total 4,381 are not represented on this graph.